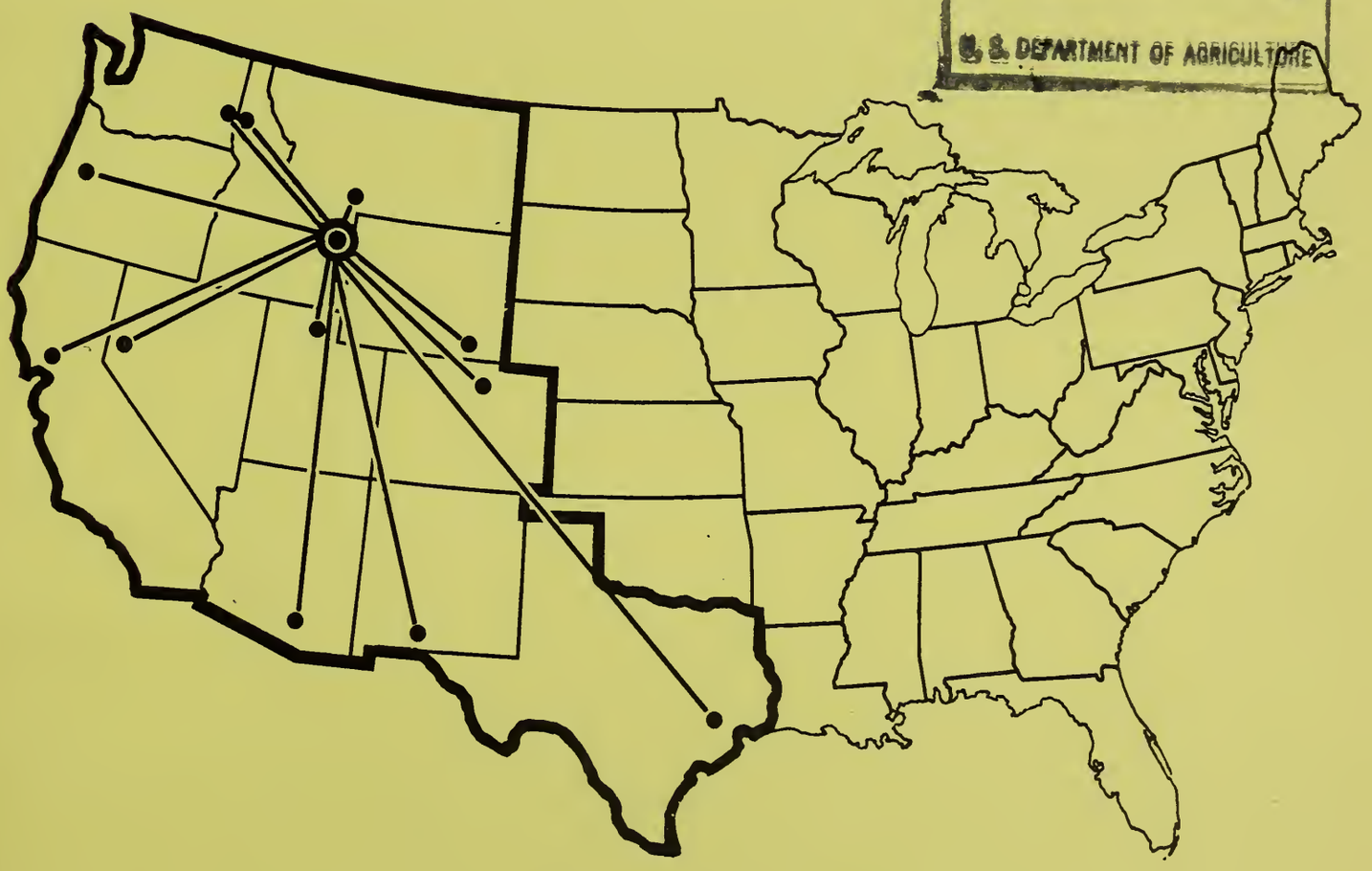
UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ANIMAL INDUSTRY
AND COOPERATING STATES

FOURTEENTH ANNUAL REPORT OF THE

U. S. SHEEP EXPERIMENT STATION
and the
WESTERN SHEEP BREEDING LABORATORY

DUBOIS, IDAHO
JUNE 30, 1951



THIS REPORT OF RESEARCH PROJECTS NOT YET COMPLETED IS INTENDED FOR THE USE OF ADMINISTRATIVE LEADERS AND WORKERS IN THIS OR RELATED FIELDS OF RESEARCH, AND NOT FOR GENERAL DISTRIBUTION.

Preface

Since authority has now been granted to consolidate the annual reports of the U. S. Sheep Experiment Station and the Western Sheep Breeding Laboratory under one cover, in order to facilitate economy and avoid unnecessary duplication, it will be noted that all publications are now listed chronologically under one heading beginning on page 6.

ANNUAL REPORT
of the
U. S. Sheep Experiment Station and Western Sheep Breeding Laboratory
Dubois, Idaho
June 30, 1951

Table of Contents

DIRECTORS OF STATE AGRICULTURAL EXPERIMENT STATIONS
OF THE TWELVE WESTERN STATES THAT ARE COLLABORATING
WITH THE WESTERN SHEEP BREEDING LABORATORY
June 30, 1951

ARIZONA:	P. S. Burgess, University of Arizona, Tucson.
CALIFORNIA:	P. F. Sharp, University of California, Berkeley.
COLORADO:	H. J. Henney, Colorado State Agricultural College, Fort Collins.
IDAHO:	Donald R.Theophilus, University of Idaho, Moscow.
MONTANA:	Clyde McKee, Montana State College, Bozeman.
NEVADA:	C. E.Fleming, Nevada Agricultural Experiment Station, University of Nevada, Reno.
NEW MEXICO:	R. A. Nichols, Director, New Mexico State College of Agriculture, State College.
OREGON:	F. E. Price, Oregon State College, Corvallis.
TEXAS:	R. D. Lewis, Agricultural and Mechanical College of Texas, College Station.
UTAH:	R. H. Walker, Utah State Agricultural College, Logan.
WASHINGTON:	Mark T. Buchanan, Washington State College, Pullman.
WYOMING:	H. M. Briggs, University of Wyoming, Laramie.

COLLABORATORS OF THE WESTERN SHEEP BREEDING LABORATORY

ARIZONA: Ernest B. Stanley, Head, Department of Animal Husbandry, College of Agriculture, University of Arizona, Tucson.

CALIFORNIA: James F. Wilson, Division of Animal Industry, College of Agriculture, University of California, Davis.

COLORADO: E. Lamar Esplin, Department of Animal Husbandry, Colorado State College of Agriculture and Mechanic Arts, Fort Collins.

IDAHO: C. W. Hickman, Head, Department of Animal Husbandry, College of Agriculture, University of Idaho, Moscow.

MONTANA: J. L. Van Horn, Department of Animal Husbandry, Montana State College, Bozeman.

NEVADA: Charles E. Fleming, Director, Nevada Agricultural Experiment Station, University of Nevada, Reno.

NEW MEXICO: Philip E. Neale, Department of Animal Husbandry, New Mexico College of Agriculture and Mechanic Arts, State College.

OREGON: F. F. McKenzie, Chairman, Department of Animal Husbandry, Oregon State Agricultural College, Corvallis.

TEXAS: Bruce L. Warwick, Department of Animal Industry, Texas Agricultural Experiment Station, Bluebonnet Farm, McGregor, Texas.

UTAH: James A. Bennett, Department of Animal Husbandry, Utah State College, Logan.

WASHINGTON: M. E. Ensminger, Head,Department of Animal Husbandry State College of Washington, Pullman.

WYOMING: Elden K. Faulkner, Department of Animal Production, College of Agriculture, University of Wyoming, Laramie.

ROSTER OF PERSONNEL

U. S. SHEEP EXPERIMENT STATION AND THE WESTERN SHEEP BREEDING LABORATORY
Dubois, Idaho
June 30, 1951

Name	Rating	Date entered on duty	General Duties
Nordby, Julius E.	Animal Husbandman	Mar. 1, 1938	Director
Terrill, Dr. Clair E.	Animal Husbandman	July 3, 1936	Genetics and Physiology
Stoehr, John A.	Animal Husbandman	Aug. 28, 1928	Operations
Kyle, Dr. Wendell H.	Animal Geneticist	July 7, 1949	Genetics and Statistics
Wiggins, Dr. Earl L.	Animal Geneticist	Oct. 2, 1950	Genetics and Physiology
Wilson, Lowell O.	Wool Technologist	July 1, 1943	Wool Technologist
Schaefer, Chester F.	Clerk	June 22, 1936	Chief Clerk
Dunn, Harry A.	Clerk	Aug. 22, 1949	Clerk
Hensley, Gladys L.	Statistical Clerk	Aug. 4, 1947	Clerk
Maloney, Helen D.	Clerk	Feb. 26, 1951	Clerk
Taylor, Jessie S.	Statistical Clerk	Aug. 25, 1947	Clerk
Vadnais, Barbara J.	Clerk	July 3, 1950	Clerk
Jeffery, Lee C.	Foreman of Farm Laborers	June 7, 1924	General maintenance Pumps, Equipment
Rasmussen, Jr., Henry	Farm Laborer	July 1, 1926	Sub-Foreman
Anderson, Daniel	Farm Laborer	Aug. 4, 1947	Shepherd
Bybee, Bert L.	Farm Laborer	April 4, 1949	Farm Laborer
Gates, Kendrick J.	Farm Laborer	Nov. 29, 1948	Shepherd
Goldman, James R.	Farm Laborer	May 1, 1939	Shepherd
Hohman, Max E.	Farm Laborer	April 1, 1935	Shepherd
Howard, John H.	Farm Laborer	Oct. 2, 1944	Camp Tender
Ingram, Parley F.	Farm Laborer	April 20, 1947	Shepherd
Phillips, Walter H.	Farm Laborer	Mar. 16, 1935	Truck Driver
Powell, Fred A.	Farm Laborer	May 11, 1935	Teamster
Swink, Albert B.	Farm Laborer	May 31, 1946	Farm Laborer
Nantz, Mrs. Dorinda R.	Laborer	June 16, 1941	Janitress & Cook

OBJECTIVE

The main objective of this Station and Laboratory is to improve sheep for lamb and wool production under range conditions. In the pursuit of this objective, basic breeding methods are employed; heritability analyses are made of the various utility factors, and the selection of breeding animals is based upon production as that is measured under range environment. Emphasis is placed primarily on the quantity and quality of lambs produced; the staple length, quality and quantity of clean scoured wool, and upon the adaptability and longevity of the sheep. To accomplish this, studies of a fundamental nature are underway employing line breeding and the testing of lines for their combining ability. Studies are also underway to improve selection practices for the utility factors mentioned above.

RESEARCH LINE PROJECTS

SRF-3-6-(1) Development of Systems of Breeding for locating strains of Rambouillet sheep that may possess inherited qualities that will improve strains with which they are crossed. Inbred lines are being developed with emphasis on selection for usefulness. The useful qualities emphasized are meat producing form, length of staple, faces free from wool blindness, heavy clean fleeces of uniform quality and high lamb production. Inbred lines are then tested for combining ability in line crosses and top crosses and these tests are compared with a non-inbred control group.

SRF-3-6-(2) Determination of inheritance of various undesirable characteristics of Rambouillet sheep. The determination of how various undesirable characteristics such as wool blindness, skin wrinkles, and hairiness in wool are inherited so that methods can be developed for eliminating these weaknesses.

SRF-3-6-(3) Studies in the physiology of reproduction of Rambouillet sheep. Studies are being made of semen quality in relation to fertility, sexual maturity of ram lambs and factors affecting fertility of ewes.

SRF-3-6-(4) Studies in the physiology of wool production of Rambouillet sheep. Studies are being made on fiber uniformity within and between various regions of the fleece. Studies are also being made of top making and spinning qualities of various sorts of Rambouillet fleeces.

BAI-b-2-1-(1) Selective mating and line breeding of Columbia and Targhee sheep for developing strains suitable to the intermountain range region. To develop and improve sheep of the white-face crossbred type for efficient and profitable lamb and wool production on western ranges.

BAI-b-2-1-(11) Development of methods for improvement of lamb production in range sheep. To develop efficient methods for improvement of lamb production in range sheep through selective breeding.

BAI-b-2-3-(1) Studies of sheep grazing management on spring-fall ranges of the intermountain region. To determine what method of grazing management with sheep will permit the fullest use of spring-fall range and, at the same time, obtain highest possible forage production.

BAI-b-2-6 Investigations of Wool and other animal fibers. To determine the physical structure and related properties of wool and other animal fibers, and the influence of breeding, feeding and management on the growth, quality and manufacturing properties of such fibers.

RM-a-427-3 Physical properties of apparel wools from animals of known breeding in relation to fabrication, felting, and insulating uses. To determine the fabrication, felting and insulating properties and the relative usefulness of different types of apparel wools from sheep of known breeding and to identify and describe breed lines and flocks of sheep in terms of fabricating, felting and insulating properties and the relative usefulness of their apparel wools.

PUBLICATIONS

The following papers have been published or mimeographed by the Western Sheep Breeding Laboratory and U. S. Sheep Experiment Station since 1937. Some publications of other agencies are included of work to which the Laboratory and Station have contributed. A number of contributions have been made to livestock journals and the general press that are not included in this series. They are for the most part adaptations of the regular series but rewritten for the lay reader. Reprints are still available for some of these publications.

1. Measurement of Reproductive Capacity as an Aid in Selection of Rams of High Fertility (A preliminary report). C. E. Terrill, Proc. of the Amer. Soc. of An. Prod., 1937, pp. 311-316.

2. Artificial Insemination of Ewes. C. E. Terrill and E. M. Gildow, National Wool Grower, 27(12):35, Dec., 1937.

3. Another Experiment on Long Range Paternity in Sheep. C. E. Terrill and E. M. Gildow. Jour. of Heredity, 29(2):77-78, Feb., 1938.

4. Artificial Insemination of Ewes with Transported Semen. E. M. Gildow and C. E. Terrill, Jour. of Amer. Vet. Med. Assoc. N. S. 46(3):157-159, Sept., 1938.

5. Reproductive Capacity of Rambouillet Ram Lambs as Indicated by Semen Tests. C. E. Terrill, Proc. of the Amer. Soc. of An. Prod., 1938, pp. 308-310.

6. A Preliminary Study of the Relation Between Fleece Characteristics of Weanling and Yearling Range Sheep. W. V. Lambert, J. I. Hardy and R. G. Schott, Proc. of the Amer. Soc. of An. Prod., 1938, pp. 298-303.

7. Reproduction in Range Sheep. C. E.Terrill and John A. Stoehr, Proc. of the Amer. Soc. of An. Prod., 1939, pp. 369-375.

8. Selection of Range Rambouillet Ewes. C. E. Terrill, Proc. of the Amer. Soc. of An. Prod., 1939, pp. 333-340.

9. Comparison of the Accuracy of Two Methods of Estimating Fineness of Wool Fibers. Ralph W. Phillips, R. G.Schott, J. I. Hardy and H. W. Wolf, Jour. of Agr. Res. 60(5):343-350, Mar. 1, 1940.

10. A Summary of Three Year's Work in the Transportation of Ram Semen for Artificial Insemination. Ralph W. Phillips, R. G. Schott, E. M. Gildow and C. E. Terrill. Proceedings of the Second National Meeting of Veterinary Surgeons of Italy, 1940. pp. 231-237.

11. The Western Sheep Breeding Laboratory and U. S. Sheep Experiment Station. Julius E. Nordby, Extension Animal Husbandman, Sept., 1940.

12. Genetics and Range Sheep Improvement. Julius E. Nordby. Scientific Monthly 51:310-320, Oct., 1940.

13. Some Factors Affecting the Progeny Testing of Rams. Ralph W. Phillips, R. G.Schott, W. V. Lambert and G. W. Brier, U.S.D.A. Cir. 580, 17 pp., Oct., 1940.

14. The Application of a Rapid Comparator Method for Determining Fineness and Variability in Wool. Elroy M. Pohle, Proc. of the Amer. Soc. of An. Prod., 1940, pp. 161-168.

15. Comparison of Ram Semen Collection Obtained by Three Different Methods for Artificial Insemination. Clair E. Terrill. Proc. Amer. Soc. of An. Prod., 1940, pp. 201-207.

16. Growth in Corriedale and Rambouillet Sheep under Range Conditions. Ralph W. Phillips, John A. Stoehr and G. W. Brier, Proc. of the Amer. Soc. of An. Prod., 1940 pp. 173-181.

17. Sheep Improvement for Range Production. Julius E. Nordby, Idaho Forester 23, 1941, Forestry School, University of Idaho.

18. A Rapid Method for expressing Medullation in Wool. Elroy M. Pohle, A. H. D. No. 41, May 1941, 6 pp. (Processed).

19. Columbia Sheep and Their Place in Range Sheep Production. Damon A. Spencer and John A. Stoehr, A.H.D. No. 42, Oct., 1941, 2 pp. (Processed).

20. Targhee Sheep and Their Place in Range Sheep Production. Damon A. Spencer and John A. Stoehr, A.H.D. No. 43, Oct., 1941, 2 pp. (Processed).

21. Face Covering in Range Sheep. Clair E. Terrill. A. H. D. No. 49, Nov., 1941, 9 pp. (Processed).

22. Wool Yield Determination in which Small Samples are Compared with Whole Fleeces. Ralph G. Schott, Elroy M. Pohle, Damon A. Spencer, and Glenn W. Brier, A.H.D. No. 50, Jan., 1942, 6 pp. (Processed).

23. Wool Yields in the Small Side-Sample as Related to Individual Whole-Fleece Yields in Four Breed-Groups of Sheep. Ralph G. Schott, Elroy M. Pohle, Damon A. Spencer and Glenn W. Brier, Jour. of An. Sci. 1(2):137-144, May, 1942.

24. The Importance of Body Weight in Selection of Range Ewes. Clair E. Terrill and John A. Stoehr. Jour. of An. Sci. 1(3):221-228, Aug., 1942.

25. Relationship between Weanling and Yearling Fleece Characters in Range Sheep. Elroy M. Pohle. Jour. of An. Sci. 1(3):229-235, Aug., 1942.

26. Staple Length in Relation to Wool Production. Elroy M. Pohle and Henry R. Keller. Jour. of An. Sci. 2(1):33-21, Feb., 1943.

27. Improving Rambouillet Sheep for Western Ranges. Julius E. Nordby. National Wool Grower 33(3):12-17, Mar., 1943.

28. Staple Length and Its Influence on Shrinkage and Fleece Values. Elroy M. Pohle, and Henry R. Keller, National Wool Grower 33(6): 22-24, June, 1943.

29. Stabilizing Wool and Body Type in White Faced Crossbred Sheep for Western Range Production. Julius E. Nordby. National Wool Grower 33(7):15-17, (8):16-18, July and August, 1943.

30. Sampling and Measuring Methods for Determining Fineness and Uniformity in Wool. Elroy M. Pohle, L. N. Hazel and H. R. Keller, U.S.D.A. Circular 704, August 1944. Revised March, 1947.

31. Wool Fineness in Eight Sampling Regions on Yearling Rambouillet Ewes. Elroy M. Pohle and R. G.Schott. Jour. of An. Sci. 2(3): 197-208, Aug., 1943.

32. Clean Wool Yield Variation Among Regions of Rambouillet Fleeces, Elroy M. Pohle, H. W.Wolf and Clair E. Terrill. Jour. of An. Sci. 2(3):181-187, Aug., 1943.

33. Fiber Density and Some Methods of its Measurement in the Fleeces of Rambouillet Sheep. H. W. Wolf, W. M. Dawson and E. M. Pohle. Jour. of An. Sci. 2(3):188-196, Aug., 1943.

34. Estimation of Clean-Fleece Weight from Grease-Fleece Weight and Staple Length. Clair E. Terrill, Elroy M. Pohle, L. Otis Emik and Lanoy N. Hazel. Jour. of Agr. Res. 70(1):1-10, Jan. 1, 1945.

35. Clean-Wool Yields in Small Samples from Eight Body Regions as related to Whole-Fleece Yields in Four Breeds of Sheep. Elroy M. Pohle and L. N. Hazel, Jour. of An. Sci. 3(2):159-165, May, 1944.

36. Shrinkage and Value by Grades for 1943 Range Wool. Elroy M. Pohle and Henry R. Keller. National Wool Grower 34(6):22-23, June, 1944. (Published in other Wool Growers Magazines).

37. Some Factors Affecting the Blood Phosphorus Level of Range Ewes. W. M. Beeson, Clair E. Terrill and D. W.Bolin. Jour. of An. Sci. 3(2):175-182, May 1944.

38. The Accuracy of Measurements and Weights of Sheep. Ralph W. Phillips and John A. Stoehr, Jour. of An. Sci. 4(3):311-316, Aug., 1945.

39. Monthly Changes in Fineness, Variability and Medullation in Hairy Lambs. Elroy M. Pohle, H. R. Keller and L. N. Hazel. Jour. of An. Sci. 4(1):37-46, Feb., 1945.

40. More Profit in Open Face Ewes. Clair E. Terrill. Mont. Wool Grower 18(1):13, 47, Jan., 1944. (Published in other Wool Growers Magazines).

41. The Influence of Location and Size of Sample in Predicting Whole-Fleece Clean Yields. E. M. Pohle, L. N. Hazel and H. R. Keller. Jour. of An. Sci. 4(2):104-112, May 1945.

42. Wool Off-sorts, Percentage, Shrink, Value. Elroy M. Pohle and Henry R. Keller, Montana Wool Grower 18(6):7, June, 1944. (Published in Other Wool Growers Magazines).

43. Effectiveness of Selection on Progeny Performance as a Supplement to Earlier Culling in Livestock. G. E. Dickerson and L. N. Hazel. Jour. of Agr. Res. 69(12):459-476, Dec. 15, 1944.

44. Looking Forward, The Stabilizing Influence of Research in a Changing Sheep Production Economy. Julius E. Nordby, National Wool Grower 35(6):18-19, 35-36, June, 1945.

45. The Etiology and Inheritance of Inequalities in the Jaws of Sheep. J. E. Nordby, C. E. Terrill, L. N. Hazel and J. A. Stoehr. Anat. Rec. 92(3):235-254, July, 1945.

46. Effects of Some Environmental Factors on Weanling Traits of Range Rambouillet Lambs. L. N. Hazel and Clair E. Terrill. Jour. of An. Sci. 4:331-341, Nov., 1945.

47. Heritability of Weaning Weight and Staple Length in Range Rambouillet Lambs. L. N. Hazel and Clair E. Terrill. Jour. of An. Sci. 4:347-353, November, 1945.

48. Heritability of Type and Condition in Range Rambouillet Lambs as Evaluated by Scoring. L. N. Hazel and Clair E. Terrill. Jour. of An. Sci. 5:55-61, February, 1946.

49. The Covariance Analysis of Multiple Classification Tables with Unequal Subclass Numbers. L. N. Hazel. Biometrics Bulletin 2(2):21-25, April, 1946.

50. Heritability of Face Covering and Neck Folds in Range Rambouillet Lambs as Evaluated by Scoring. Clair E. Terrill and L. N. Hazel. Jour. of An. Sci. 5(2):170-179, May, 1946.

51. Effects of Some Environmental Factors on Weanling Traits of Range Columbia, Corriedale and Targhee Lambs. L. N. Hazel and Clair E. Terrill. Jour. of An.Sci. 5(3):318-325, August, 1946.

52. Heritability of Weanling Traits in Range Columbia, Corriedale and Targhee Lambs. L. N. Hazel, and Clair E. Terrill. Jour. of An. Sci. 5(4):371-377, November, 1946.

53. Effects of Some Environmental Factors on Fleece and Body Characteristics of Range Rambouillet Yearling Ewes. L. N. Hazel and Clair E. Terrill. Jour. of An. Sci. 5(4):382-388, Nov., 1946.

54. Length of Gestation in Range Sheep. Clair E. Terrill and L. N. Hazel. Amer. Jour. Vet. Res. 8(26):66-72, January, 1947.

55. Refining Methods of Using Opal Blue Stain in Evaluating Ram Semen. L. O. Emik and G. M. Sidwell. Jour. of An. Sci. 6(1):67-71, Feb., 1947.

56. Breed Crosses Used in the Development of Targhee Sheep. Clair E. Terrill. Jour. of An. Sci. 6(1):83-92, February, 1947.

57. Range Sheep Improvement Through Selection. Clair E. Terrill. National Wool Grower 36(12):17-19, December, 1946.

58. Color on the Legs of Sheep. Its Inheritance in the Columbia and Targhee Breeds. Clair E. Terrill. Jour. Hered. 38(3):89-92, March, 1947.

59. Effects of Some Environmental Factors on Yearling Traits of Columbia and Targhee Ewes. Clair E. Terrill, G. M. Sidwell and L. N. Hazel. Jour. An. Sci. 6(2):115-122, May, 1947.

60. It's the Clean Wool in the Fleece that Pays Off. Elroy M. Pohle. National Wool Grower 37(5):19-20, May, 1947.

61. Statistical Treatment of Trichostrongylid Eggs. L. Otis Emik. Biometrics 3(2):89-93, June, 1947.

62. Factors Affecting the Estimation of Concentration of Ram's Semen by the Photoelectrometric Method. L. Otis Emik and George M. Sidwell. Jour. of An. Sci. 6(4):467-475, November, 1947.

63. Development of Targhee Sheep. Clair E. Terrill and John A. Stoehr. National Wool Grower, 37(11):13-14, Nov., 1947.

64. Tailless Sperm from Rams. L. Otis Emik and George M. Sidwell. Jour. of An.Sci. 8(1):67-72, Feb., 1949.

65. Gestation Period in Sheep. Clair E.Terrill and John A. Stoehr. Sheep and Goat Raiser 28(6):23, March, 1948. (Published in other Wool Growers Magazines).

66. Effects of Some Environmental Factors on Yearling Traits of Columbia and Targhee Rams. Clair E. Terrill, G. M. Sidwell and L. N. Hazel. Jour. of An. Sci. 7(2):181-190, May, 1948.

67. Effects of Some Environmental Factors on Traits of Yearling and Mature Rambouillet Rams. Clair E. Terrill, G. M. Sidwell and L. N. Hazel. Jour. of An. Sci. 7(3):311-319, Aug., 1948.

68. Improvement of Sheep for Western Ranges. Julius E. Nordby. To Appear as a U.S.D.A. Misc. Publication.

69. Effect of Feed and Sickness on Wool Growth. Elroy M. Pohle. National Woolgrower 37(6):9, June, 1947.

70. High Producing Rams Important. Elroy M. Pohle. National Woolgrower 38(1):21-22, January, 1948.

71. Fleece Value Increases with Staple Length. Thos. D. Watkins, Jr. National Wool Grower 38(10):17-18, October, 1948. (Published in other Wool Growers Magazines).

72. Systematic Procedures for Calculating Inbreeding Coefficients. L. Otis Emik and Clair E.Terrill. Journal of Heredity 40(2): 51-55, Feb., 1949.

73. Increasing Accuracy of Selecting Rams. Clair E. Terrill. To be processed by A. H. Div., Bur. of An. Inds., U.S.D.A.

74. The Relation of Face Covering to Lamb and Wool Production in Range Rambouillet Ewes. Clair E. Terrill. Jour. of An. Sci. 8(3):353-361, Aug., 1949.

75. Activating Genetic Concept into Range Sheep Improvement. Julius E. Nordby. Northwest Science 22(2):60-68, May, 1948.

76. The Effects of Environmental and Hereditary Factors on Trichostrongylid Worm Infestation in Sheep. L. Otis Emik. Jour. of An. Sci. 8(1):73-80, Feb., 1949.

77. Science as a Means of Sheep Improvement. Julius E. Nordby. Montana Wool Grower 23(1):17, 64, January, 1949.

78. Dangers and Benefits of Inbreeding. Julius E. Nordby. National Wool Grower 39(1):12-13, 40, 42, January, 1949.

79. Some Profitable Improvements in Rambouillet Sheep. Julius E. Nordby. San Angelo Standard Times, May 1, 1949.

80. More Lambs from Open-Faced Ewes. Clair E. Terrill. National Wool Grower 40(6):15, 34, June, 1950.

81. Wintering Ewe Lambs. John A. Stoehr and Clair E. Terrill. National Wool Grower 40(2):14-15, February, 1950.

82. Comparison of Elastrator with Cutting for Docking and Castrating. Clair E. Terrill and John A. Stoehr. National Wool Grower 40(3): 23, March, 1950.

83. Selecting Rambouillet Ewes for High Lamb Production. Clair E. Terrill. For Journal of Animal Science.

84. Stocking Northern Great Plains Sheep Range for Sustained High Production. E. J. Woolfolk. U.S.D.A. Cir. 804, 39 pp., April, 1949. (Sheep from the U. S. Sheep Experiment Station were used in this study).

85. Grazing Spring-Fall Sheep Ranges of Southern Idaho. J. F. Pechanec and George Stewart. U.S.D.A. Cir. 808, 34 pp. May, 1949.

86. The Semen Production of Rams under Range Conditions. L. Otis Emik and Clair E. Terrill. For Journal of Animal Science.

87. The Effect of Successful Embryo Transplantations on the Progress Expected from Selection. W. H. Kyle. For Journal of Animal Science.

88. Effectiveness of Selection for Economically Important Traits of Sheep. Clair E. Terrill. For Journal of Animal Science.

89. The Influence of Research upon Sheep Production Economy. Julius E. Nordby. San Angelo Standard Times, April 20, 1950.

90. Keep Range Livestock on Job Building Soil. A Condensation of Talk given at the Annual Meeting of the Idaho Soil Conservation District Supervisors at Lewiston, Idaho, November 7, 1949. Julius E. Nordby. Idaho Farmer, January 5, 1950.

91. Increased Usefulness is Evolving to make a Good Breed of Sheep Better. Julius E. Nordby. 1950. Rambouillet Yearbook published by the American Rambouillet Sheep Breeders Association, San Angelo, Texas.

92. Selection Indexes for Improvement of Sheep. Clair E. Terrill. Proc. Ann. Meeting West. Sec. Amer. Soc. of An. Prod., Logan, Utah, July 10-12, 1950. (Processed).

93. Wool Growth as Affected by Environment and Other Factors. John I. Hardy. Tex. Res. Jour. 20(3):189-193. March, 1950.

94. Effects of Spring and Fall Grazing by Sheep on Vegetation of the Upper Snake River Plains. Walter F. Mueggler. Jour. of Range Management 3(4):308-315, Oct., 1950.

95. Correlations Between Traits of Range Rambouillet Rams. Clair E. Terrill, W. H. Kyle and L. N. Hazel. For U.S.D.A. Circular.

96. Some Problems in Meat and Wool Improvement Balance. Julius E. Nordby. National Wool Grower 41(8):17, 20, 23, 24, August, 1951.

ABSTRACTS

The following abstracts have been published by the Western Sheep Breeding Laboratory and U. S. Sheep Experiment Station since 1937. In general these are abstracts of work that has been or will be published and listed in the regular series of publications.

1. Relationship Between Weanling and Yearling Fleece Characters in Range Sheep. Elroy M. Pohle. Jour. of An. Sci. 1(1):60, Feb., 1942.

2. The Importance of Body Weight in Selection of Range Ewes. Clair E. Terrill and John A. Stoehr. Jour. of An. Sci. 1(1):60-61, Feb., 1942.

3. Fineness of Fiber in Eight Sampling Areas on Yearling Rambouillet Ewes. Elroy M. Pohle and R. G.Schott. Jour. of An. Sci. 1(4): 356, Nov., 1942.

4. Clean Wool Yield Variation Among Regions of Rambouillet Fleeces. Elroy M. Pohle, H. W. Wolf and Clair E. Terrill. Jour. of An. Sci. 1(4):356, Nov., 1942.

5. Estimation of Clean Fleece Weight from Unscoured Fleece Weight and Staple Length. Clair E. Terrill, Elroy M. Pohle and L. Otis Emik. Jour. of An. Sci. 1(4):357, Nov., 1942.

6. A Study of the Fiber Density of the Fleeces of Rambouillet Sheep. H. W. Wolf, W. M. Dawson and E. M. Pohle. Jour. of An. Sci. 1(4):357, 358, Nov., 1942.

7. Heritability of Yearling Fleece and Body Traits of Range Rambouillet Ewes. Clair E. Terrill and Lanoy N. Hazel. Jour. of An. Sci. 2(4):358-359, Nov., 1943.

8. The Effect of Some Factors on the Blood Phosphorus Level of Range Ewes. W. M. Beeson, Clair E. Terrill and D. W. Bolin. Jour. of An. Sci. 2(4):369, Nov., 1943.

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BREEDING PLANS 1950-51

A total of 2554 ewes were bred in 1950. Rambouillet pen breeding extended from November 3 to December 4 and range breeding from December 11 to December 27 (Range breeding here refers to the practice of turning rams into the band about a week after the ewes come out of pen breeding, to settle ewes that may not have conceived from pen breeding). Columbia and Targhee ewes were bred from November 20 to December 22. The distribution of ewes by breed and type of mating is shown in the following table:

Breed	No. of ewes bred	Inbred lines		Breed crosses		Line crosses		Selected Controls		Test ewes		Black* markers	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Rambouillet	1310	808	62			224	17	198	15	70	5	10	1
Targhee	690	455	66	27	4					195	28	13	2
Columbia	554	355	64			136	25			63	11		
ALL	2554	1618	63	27	1	360	14	198	8	328	13	23	1

* Black marker ewes were not used in the breeding program.

About 63 percent of all ewes were bred in inbred lines and 14 percent in line crosses. The one percent in breed crosses will probably contribute to lines. Many of the test ewes and some of the sire crosses are used in developing lines by recurrent selection. About 8 percent of the total number are used for selected controls and one percent for black markers.

Rambouillet lines:

There are 29 lines of Rambouillets. The average number of ewes per line is 27.9 as compared with 29.3 last year. There are 6 lines of registered horned Rambouillets and 18 lines of unregistered horned Rambouillets. There are 2 lines of registered polled Rambouillets and 3 lines of unregistered polled Rambouillets.

Rambouillet cross lines:

The plan for testing Rambouillet lines for crossing ability was identical with that for last year. Twenty ewes were taken at random from lines 22, 40, 45, 49, 50 and 51. The ewes from each line were sorted at random to 2 sires from each of lines 21, 23, 25, 43 and 44. The 2 sires from each of these 5 sire lines were each mated to half of the ewes from his own line and to 12 ewes from the 6 lines of dams (2 ewes from each line). In addition 2 ewes each from lines 25 and 44 were mated to one sire from each of lines 22, 40, 45, 49 and 51 to provide some reciprocal matings for evaluation of maternal effects.

Rambouillet selected control group:

Six rams were used including one 2-year old that had been progeny tested, 2 yearling rams and 3 ram lambs.

Rambouillet recurrent selection and test matings:

This involved mating 16 rams from 2 pairs of lines. Four rams from each line were each mated to 5 ewes from the other line of the pair. In addition 4 or 5 test ewes were mated to each of the 16 rams. The procedure is described in detail later in the report. All Rambouillet test ewes were mated to sires under recurrent selection.

Targhee lines:

A total of 455 ewes were mated in 17 lines with an average of 26.8 ewes per line. Eight of these lines were initiated in 1940. Another line was started from Columbia x Rambouillet crosses which were first made in 1943. Four lines were started from Rambouillet lines crossed with Corriedale lines. The first crosses were started in 1945. A few Corriedale ewes are still being mated to Rambouillet rams. One line resulted from crosses of New Zealand Merino rams on Columbia, Targhee and Rambouillet ewes. The first crosses were made in 1945. The remaining 3 lines were split from lines 4T, 9T and 15T for use in recurrent selection. In addition, some ewes with Border Leicester breeding are being crossed with Rambouillet rams to produce Targhee type offspring.

Targhee recurrent selection and test matings:

Six rams from each of 3 lines were tested by top crossing with about 10 test ewes per ram. The procedure is described in detail later in the report.

Columbia lines:

There were 10 inbred lines of Columbias with an average of 35.5 ewes per line. These lines were started in 1940 although relationship existing before that time was taken into account when the lines were divided from the Columbia stock on hand.

Columbia cross lines:

Crossline matings were made with 5 of the 10 Columbia lines (2, 4, 8, 9 and 10). Each of two sires from each of the lines was mated with 13 or 14 crossline ewes. These ewes were produced from crosses of 2 to 4 lines made in previous years. In most cases the sire was not mated to crossline ewes descended from his own line.

Columbia test matings:

Columbia test ewes consisting of ewes of the LR, K1B, K2 and K series were sorted at random to 3 rams from line 5.

PROGRESS IN DEVELOPING INBRED LINES

Rambouillets:

The following table shows the change in inbreeding since the first inbred offspring were produced in 1938. These data are based on ewes bred.

Average Inbreeding Coefficients in Percent

Year lambed	No. of lines	No. of ewes bred	Sires	Dams	Progeny	Increase of progeny over dams	Highest for progeny of any pen	Highest for any individual offspring
1938	20	500	4.0	1.1	3.9	2.8	13.3	37.9
1939	22	560	7.5	3.2	7.2	4.0	30.3	58.3
1940	34	805	6.0	3.6	8.2	4.6	32.6	58.3
1941	36	850	3.3	2.7	8.6	5.9	31.2	47.3
1942	37	1023	4.1	4.0	8.6	4.6	28.7	39.9
1943	30	903	4.4	4.2	8.9	4.7	23.0	36.9
1944	30	908	5.0	5.0	10.3	5.3	22.8	48.0
1945	30	962	6.0	5.8	14.2	8.4	26.8	42.5
1946	30	890	5.9	7.1	14.1	7.0	25.7	39.4
1947	30	897	8.6	8.1	15.6	7.5	29.0	55.2
1948	29	882	14.6	9.7	17.1	7.4	30.5	42.9
1949	29	1002	13.4	11.9	15.8	3.9	32.6	44.2
1950	29	851	13.6	13.6	16.8	3.2	32.4	46.0

The average inbreeding coefficients increased for both sires and offspring in 1950 but they did not exceed the high year of 1948 which was prior to the introduction of outcrosses in lines 24, 32, 34 and 39. The average inbreeding of dams continued to increase because it is not yet affected by the introduction of outside sires.

The average inbreeding coefficient of all ram lambs weaned in inbred lines in 1950 was 15.8 percent, and of those saved was 14.8 percent. The respective averages for ewe lambs were 15.8 and 15.6 percent.

The six highest ranking lines for each of the important traits measured at weanling age are listed in the next table for comparison with similar tables presented in previous years. These lines were ranked on adjusted averages from weanling offspring in 1950. Averages of offspring from each of 2 sires from the same line were given equal weight to obtain one value for the line.

Rank of Lines

Trait	1st	2nd	3rd	4th	5th	6th
Body weight	27	36	25	40	28	47
Body type	36	42	44	47	45	22
Condition	24	36	27	19	20	26
Staple length	44	37	47	45	21	36
Open face	40	50	27	35	51	22
Freedom from folds	44*	47*	50*	42	24	37
Index	50	40	27	47	22	36

* Lambs from lines 44, 47 and 50 were all scored as perfectly smooth.

Offspring of line 34 were excluded because an outcross was made from which all offspring were culled (the ram sired a black lamb).

Nineteen of the 28 lines are included in the table of which 15 were included last year. Three lines (40, 44 and 47) have ranked in the high six for one or more traits for each of the last 10 years, but not necessarily for the same trait each year.

Targhees:

The Targhee lines which were established in 1940 were continued by using one ram in each line. The inbreeding progress in these lines is shown in the following table:

Year lambed	No. of lines	No. of ewes bred	Average inbreeding coefficients in percent: Sires	Dams	Progeny	Increase of progeny over dams	Highest for progeny of any pen	Highest for any individual offspring
1941	8	192	8.2	3.5	9.6	6.1	16.4	30.9
1942	8	183	8.5	3.5	10.6	7.1	17.4	34.9
1943	8	202	7.2	3.5	10.6	7.1	22.5	34.9
1944	8	223	8.7	4.6	11.2	6.6	16.0	31.0
1945	8	257	5.0	7.5	13.1	5.6	20.8	35.9
1946	8	245	3.4	7.2	11.5	4.3	18.9	36.2
1947	8	267	5.5	8.0	13.5	5.5	21.9	41.4
1948	7	226	11.4	8.4	16.3	7.9	19.8	44.7
1949	8	255	14.2	9.4	16.9	7.5	23.4	35.2
1950	8	224	9.8	10.7	16.5	5.8	25.5	34.9

The sires of the 1950 lambs were less inbred than the sires of the 1948 and 1949 lambs. This may have accounted for the slight decline in the average inbreeding of the progeny.

An additional 6 lines which have been started in recent years are not included in the table because inbreeding coefficients have not yet been calculated for all of these lines and because first crosses are still being made for some of these lines. In addition, 17 ewes having Border Leicester Blood were mated to a polled Rambouillet ram. Offspring of these matings, if suitable, may be used later in Targhee breeding.

The 4 highest ranking lines (of 14 lines) for each of the important traits measured at weanling age are listed in the next table. These lines were ranked on adjusted averages from weanling offspring in 1950. None of the 14 lines are included in the table.

Trait	1st	2nd	3rd	4th
Body weight	1T	3T	11T	7T
Body type	7T	3T	1T	11T
Condition	3T	7T	1T	4T
Staple length	7T	11T	1T	8T
Open face	1T	13T	3T	9T
Freedom from folds	2T	8T*	13T*	11T
Index	1T	11T	9T	3T

* Identical scores.

Columbias:

The 10 Columbia lines which were started in 1940 were continued in the fall of 1950. The inbreeding charts are complete for these lines but the tabulations for parents and progeny by years are not yet complete.

The first 4 lines for each of the important traits measured at weanling age are listed in the next table. These lines were ranked on adjusted averages from weanling offspring in 1950. Columbia lines were not ranked on face covering and freedom from folds as practically all Columbias have open faces and are free from folds. Eight of the 10 lines are included in the table.

Trait	1st	2nd	3rd	4th
Body weight	2	6	3	5
Body type	2	6	7	3
Condition	6	7	2	3
Staple length	1	9	4	2

RECURRENT SELECTION

Recurrent selection refers to the development of lines by selecting individuals for crossing or combining ability with other lines or with a tester stock. It appears that it may be difficult with sheep because the reproductive rate may be too low to maintain sufficient ewes for both straight-line and cross-line matings. It may be necessary to use a rotation scheme of testing or to maintain a separate source of tester ewes in order to carry on the plan with sheep. Preliminary work has been started to determine effective ways of carrying on such selection in inbred lines of sheep.

Rambouillets:

Test matings were initiated in the fall of 1950 by mating rams from 2 pairs of lines (20 and 27, 53 and 54) with ewes of the other line in each pair. About half of the ewes (sorted out at random) from each line were mated with a ram from that line and the other half were distributed at random to 4 rams from the other line. The ram having the best cross offspring for non-additive traits (those which show hybrid vigor in crosses and are most affected by inbreeding) will be used in the line the following year. The initial selection of rams to be tested will be based on additive traits such as face covering, neck folds and staple length. Polledness will be considered in initial selection for lines 53 and 54 which are being developed as polled lines. Ewes will be culled for crippling defects only, such as any trait that interferes with reproductivity and liveability.

Targhees:

Each of 3 lines of diverse genetic origin were divided at random into 2 equal groups in the fall of 1950. One group from each line (4T, 9T and 15T) will be continued as the original inbred line, as in the past, with selection based on the individual's own phenotypic merit and with no progeny testing. The other group from each line (designated as lines 16T, 17T and 18T respectively) will be used in a system of recurrent selection which started in the fall of 1950 with the use of test ewes from outside the line (6 pens of 10 ewes each for each line). The sire from each line, out of the 6 sires tested, having the best cross progeny for non-additive traits will be used in the line the following year. After the first 2 years, test ewes will be rotated among the sire lines so that rams from 16T will be tested on offspring of rams from 17T and rams from 17T will be tested on offspring of rams from 18T, etc.. Eventually, rams from 16T will be tested on ewes which have received (theoretically) 57% of their inheritance from 17T, 29% from 18T and 14% from 16T.

EFFECTS OF INBREEDING

Rambouillet weanling lambs:

The effect of inbreeding on staple length, weaning weight and index was studied on 3,389 Rambouillet lambs from inbred lines born

from 1945 through 1948. The object was to determine if there are line or yearly differences in the effects of inbreeding on these traits.

Gross correlation and regression coefficients of the various traits on inbreeding are shown in the following table:

Year	Staple length		Weaning weight		Index	
	r	b	r	b	r	b
1945	.11**	.006**	-.27**	-.31**	-.11**	-.16**
1946	.01	.001	-.21**	-.28**	-.18**	-.33**
1947	-.01	-.001	-.18**	-.21**	-.08*	-.15*
1948	.03	.002	-.22**	-.27**	-.17**	-.28**
ALL	.04	.002	-.22**	-.27**	-.13**	-.23**

* Significant at the 5% level
** Significant at the 1% level

The effect of inbreeding was greatest on weaning weight and least on staple length. The correlation of inbreeding with staple length was significant in only one of the 4 years and the effect of inbreeding on staple length does not appear to be important. The correlation of inbreeding with weaning weight and index was significantly negative in each year. The average regression coefficients for weaning weight and index on inbreeding were lower than in 1941 and 42 when coefficients of -0.375 and -0.31 were obtained for weaning weight and index, respectively. There was no evidence of any change in uniformity within lines from 1941 to 1948 but the expected change (a decrease of about 2 to 3% in the standard deviation) is probably too small to be revealed in these data. The deviation from average of the individual regressions for years was not significant. Thus, it appears that within the group studied, the effects of inbreeding were uniform for years. The differences among the yearly regressions of weaning weight and index on inbreeding are large enough that it may be desirable where possible to base corrections for inbreeding on the data to which they are to be applied.

The pooled intra-year regressions of weaning weight and index on inbreeding for the individual lines did not differ significantly. Thus, lines were uniform in the rate of loss from inbreeding. Only one line for weaning weight and 10 lines for index showed positive correlations with inbreeding and none were significant. Therefore there is no evidence in this study that any lines are improving with inbreeding.

It is planned to study more data before definite conclusions are drawn.

Rambouillet rams:

The effect of inbreeding is used to adjust all ram records to a comparable, non-inbred basis. Use of this method for removing variation due to inbreeding should increase the accuracy of selection. Additional

information was obtained during the year on the effect of inbreeding on various traits for 752 Rambouillet rams born from 1942 to 1948.

Inbreeding had significant detrimental effects on body weight, grease fleece weight, clean fleece weight, type, condition, face covering and staple length. The average decline at yearling age for the respective traits for each increase of one percent of inbreeding was 0.48 lbs., 0.05 lb., 0.02 lb., 0.03 score, 0.02 score, 0.02 score and 0.008 cm.. The effect of inbreeding on staple length was barely significant at yearling age only, while the effect on the other traits was fairly constant through 3 years of age which was the oldest group studied. The effects were greater than those previously reported for staple length, type, condition, and face covering and slightly smaller than those previously reported for grease fleece weight and body weight.

A significant decrease in neck folds (smoother) of -0.014 score was shown at yearling age for each increase of one percent in inbreeding. This was greater than the regression of -0.004 score which was previously reported.

Clean yield, fiber diameter and belly wool tended to decrease slightly, and variability of fiber diameter to increase slightly with inbreeding, but these effects were small and not significant.

These gross regressions may include effects of line differences in inbreeding where the more highly inbred lines may happen to be smoother and have more covered faces while some lines with less inbreeding may have more open faces and more neck folds. Selection of rams may magnify these effects.

LINE CROSSES

Rambouillets:

The testing of some Rambouillet lines for combining ability was continued in 1950 with the same plan as in 1949.

Some preliminary results from cross-line lambs born in 1950 are tabulated as follows:

	No. of offspring from		Ave. weaning weight of offspring from			Ave. condition scores of offspring from		
Sire line	Own line	Line crosses	Own line	Line crosses	Dam lines	Own line	Line crosses	Dam lines
21	15	18	76.4	81.5	79.4	2.3	2.0	2.5
23	21	23	79.8	76.7	79.1	2.4	2.4	2.4
25	13	24	84.4	77.4	79.4	2.3	2.2	2.5
43	9	17	72.7	71.7	79.4	2.3	2.3	2.5
44	20	26	78.9	77.0	79.2	2.3	2.5	2.4

	No. of offspring from		Ave. type scores of offspring from			Ave. indexes of offspring from		
Sire line	Own line	Line crosses	Own line	Line crosses	Dam lines	Own line	Line crosses	Dam lines
21	15	18	1.8	1.4	1.7	113.9	121.2	130.4
23	21	23	1.8	1.7	1.7	116.0	114.7	127.5
25	13	24	1.7	1.6	1.7	124.4	123.8	128.2
43	9	17	2.1	1.8	1.7	102.1	115.0	128.9
44	20	26	1.6	1.6	1.7	125.5	127.1	128.3

These data have been corrected for environmental effects except that data for cross-line offspring have not been corrected for the inbreeding which may exist because of relationship between the lines. Averages for sires within lines have been combined by giving equal weight to each sire. Averages for offspring of dam lines have been weighted by the number of cross line offspring from each dam line.

Evidences of crossing ability are not marked in these data. Line 21 shows gains over parent lines for weight, type and condition and line 25 for type and condition. Cross-line lambs were as good or better than those of parent lines in 4 or 5 cases for both type and condition scores (lower scores indicate higher merit). The average indexes of the crossline offspring excelled the midpoint of the parent lines in only one of the 5 cases. However, the index emphasizes the more highly heritable (additive) traits which would not be expected to

show hybrid vigor or heterosis. On the additive basis crossline lambs should equal the average of the two parent lines. Definite conclusions cannot be reached until additional data and the inbreeding coefficients of crossline lambs are available.

Columbias:

Studies of the advantages of line-cross lambs over inbred lambs of Columbias were continued for 1950 lambs. None of the data were adjusted for inbreeding. Inbred lambs from sire lines used in crossing were inferior to inbred lambs from all lines except for face covering. Crossline lambs excelled all inbred lambs for every trait. The advantages were 4% for face covering and staple length, 2% for weaning weight and type score and 1% for condition score. These differences may simply reflect the differences in inbreeding. Calculation of inbreeding coefficients for Columbias will soon be complete and this can be checked.

Sire lines 2, 4, 8, 9 and 10 were mated to random samples of crossline ewes. These ewes were the result of two-line and three-line crosses. Two sires were used for each line but only one sire from line 9 produced offspring. Each ram was mated to half of the ewes from his own line in addition to the cross-line ewes. Data on the offspring of these matings are presented in the following tables:

Sire line	No. of offspring from		Ave. staple length of offspring from		Ave. weaning weight offspring from	
	Own line	Crosslines	Own line	Crosslines	Own line	Crosslines
2	37	19	4.8	4.9	86.6	85.2
4	31	21	4.9	5.1	74.7	83.2
8	28	17	4.7	5.2	78.3	82.4
9	13	10	4.9	5.2	80.5	85.0
10	32	19	4.4	5.0	81.7	86.5

Sire line	No. of offspring from		Ave. type score of offspring from		Ave. condition score of offspring from	
	Own line	Crosslines	Own line	Crosslines	Own line	Crosslines
2	37	19	1.3	1.5	2.2	2.3
4	31	21	1.6	1.5	2.4	2.2
8	28	17	1.6	1.4	2.3	2.2
9	13	10	1.6	1.2	2.6	2.2
10	32	19	1.5	1.4	2.3	2.3

It appears from these preliminary results that averages for crossline progeny follow the rank of those for inbred progeny more closely for staple length and weaning weight than for type and condition scores. This would be expected from the relative heritabilities of these traits.

SELECTED NON-INBRED CONTROL GROUP

This breeding group of Rambouillets was started in the fall of 1947 to serve as a control group to compare improvement resulting from the utilization of inbred lines with that resulting from selection without inbreeding. In the first two years it was necessary to use sires from outside the group. The majority of lambs born in 1950 were sired by rams selected from the control group.

A comparison of the averages (adjusted for environmental effects and inbreeding) of weanling offspring of the control group with those of the inbred lines for 1948 to 1950 is shown in the following table:

Group	Year	No. of lambs	Inbr. coef. %	Face covering score	Staple length (cm.)	Weaning weight (lbs.)	Type score	Condition score	Neck folds score	Index
Inbred Lines	1948	871	15.8	4.18	3.16	73.97	1.95	2.21	1.21	113.5
	1949	838	14.9	4.04	3.34	76.59	1.94	2.67	1.20	123.3
	1950	647	15.8	4.10	3.44	78.67	1.69	2.37	1.12	122.0
Non-inbred Control	1948	180	1.9	4.01	3.31	72.70	1.92	2.32	1.23	116.5
	1949	189	1.9	4.06	3.53	75.25	1.89	2.70	1.20	123.2
	1950	170	1.9	3.69	3.54	78.50	1.67	2.40	1.16	128.9

As expected, there was little real difference in the two groups in the first 2 years. The control group had slightly longer staple, lighter weaning weights, better type and poorer condition. In the third year, when the effects of selection within the control group should have become apparent, there was definite improvement in face covering as compared with the inbred lines but little change in the relative gains for the other traits.

SELECTION PRACTICED ON WEANLING LAMBS

Weanling selection differentials represent the average differences between selected lambs and all lambs weaned, after corrections for environmental influences have been made. Considerable later selection is practiced on rams but most of the effective selection of ewes for fleece and body traits is made at weanling age. The relative emphasis on each trait was obtained by dividing the selection differential by the standard deviation for each breed.

Heritability estimates were obtained from 1941 and 1942 weanling lambs for Rambouillets and from 1941 to 1944 weanling lambs for Columbias

and Targhees. Average estimates from Corriedale, Columbia and Targhee lambs are used for the latter two breeds as there were insufficient numbers within each breed to obtain reliable estimates.

The expected genetic gain per generation for each sex is the selection differential times one-half of the heritability. The sum of the products for both sexes gives the expected genetic gain per generation from selection practiced at weanling age on both sexes. These are relative gains because not all lambs saved at weaning will produce offspring.

Annual genetic improvement, estimated from selections at weanling age, depends partly on the length of the generation interval, which is the average age of the parents when their offspring are born. The estimated annual genetic improvement resulting from weanling selections is the expected gain per generation from selection of both sexes divided by the generation interval. The generation interval which should be applied to these data would be the age when these offspring produce progeny. This can only be estimated now from the average age of the present parents.

Rambouillets:

The proportion of lambs saved was higher for both sexes than in most recent years. In 1950, 40% of the ram lambs and 78% of the ewe lambs were saved as compared with 32% and 69% respectively in 1949. Selection differentials and expected gains from weanling selections of Rambouillets in 1950 are shown in the following table:

	Face covering score	Staple length (cm.)	Weaning weight (lbs.)	Type score	Condition score	Neck folds score
Heritability	56%	40%	30%	13%	4%	39%
RAMS						
Selection differential	.31	.09	4.09	.23	.13	.07
Expected genetic gain per generation	.087	.018	.614	.015	.003	.014
EWES						
Selection differential	.09	.05	1.03	.06	.03	.02
Expected genetic gain per generation	.021	.010	.154	.004	.001	.004
RAMS & EWES						
Expected genetic gain per generation	.108	.028	.768	.019	.004	.018
Selection differentials expressed as fractions of a standard deviation.						
RAMS	.51	.20	.48	.48	.30	.23
EWES	.15	.11	.12	.12	.07	.07

Selection differentials for Rambouillet lambs were generally lower in 1950 than in 1949 with the exception of face covering in ram lambs. The decrease can be attributed, at least in part, to the higher proportions of lambs saved. The relative emphasis was greatest for face covering followed by weaning weight and type score in both sexes.

The average age of Rambouillet sires and dams when their offspring were born, given in the following table, was revised this year to a basis of the age of actual parents weighted by the number of lambs weaned rather than the average age of all ewes bred and all sires used.

Year lambs were born	Average age of: Sires (years)	Dams (years)	Sires & Dams (years)
1944	3.42	4.36	3.890
1945	3.45	4.28	3.865
1946	2.72	4.31	3.515
1947	2.38	4.31	3.345
1948	1.96	4.26	3.110
1949	2.23	4.26	3.245
1950	2.47	3.95	3.210

Generation length based on both sires and dams decreased from 1944 to 1948. Since then the average age of sires has increased while that for dams decreased in 1950. The two ram lamb sires in 1950 were both in small pens. There was a tendency in 1950 to use 3 and 4 year old rams in many of the lines where 2 rams were used in connection with the line cross tests.

The estimated annual genetic gain from weanling selections of Rambouillets from 1944 to 1950 are shown in the following table:

Year	Face covering score	Staple length (cms.)	Weaning weight (lbs.)	Type score	Condition score	Neck folds score
1944	.019	.011	.223	.009	.002	.029
1945	.024	.014	.306	.011	.002	.019
1946	.041	.015	.325	.006	.002	.017
1947	.040	.015	.374	.007	.001	.018
1948	.034	.015	.383	.008	.002	.006
1949	.032	.014	.339	.006	.002	.009
1950	.034	.009	.239	.006	.001	.006

The rates increased in 1950 over 1949 for face covering, remained stationary for type and decreased for all other traits. The decreases in 1950, in spite of a slightly shorter generation interval than in 1949, may be due to the higher proportions of lambs saved. If so, this may be counteracted by later selections particularly for rams.

Targhees

More Targhee lambs of both sexes were saved in 1950 than in 1949. In 1950, 54% of the ram lambs and 75% of the ewe lambs were saved as compared with 37% and 59%, respectively, for 1949. Selection statistics for Targhee weanling lambs in 1950 are given in the following table:

	Face covering score	Staple length (cm.)	Weaning weight (lbs.)	Type score	Condition score	Neck folds score
Heritability	46%	43%	17%	7%	21%	8%
RAMS						
Selection differential	.29	.07	3.56	.16	.14	.07
Expected genetic gain per generation	.067	.015	.303	.006	.015	.003
EWES						
Selection differential	.08	00	1.17	.05	.08	00
Expected genetic gain per generation	.018	00	.099	.002	.008	00
RAMS & EWES						
Expected genetic gain per generation	.085	.015	.402	.008	.023	.003
Selection differentials expressed as fractions of a standard deviation.						
RAMS	.49	.16	.36	.35	.27	.23
EWES	.14	0	.12	.11	.16	0

Selection differentials for weanling Targhees were lower than for the previous year in every case, possibly because of the higher proportions saved. Relative emphasis in ram lambs was greatest for face covering followed by weaning weight and type, while greatest emphasis in ewe lambs was placed on condition followed by the above traits in the same order. Staple length and neck folds received the least emphasis in both sexes.

The average age of Targhee sires and dams when their offspring were born are given in the following table:

Year lambs were born	Average age of: Sires (years)	Dams (years)	Sires & Dams (years)
1944	2.90	4.27	3.588
1945	2.15	4.52	3.334
1946	3.32	4.52	3.916
1947	2.39	4.32	3.355
1948	2.02	3.97	2.992
1949	2.36	3.75	3.059
1950	2.06	3.82	2.940

Generation length based on both sires and dams was lower in 1950 than for any other year included in the table although sires were younger in 1948 and dams were younger in 1949. Dams have been younger since 1947 than in previous years because of the initiation of new lines from breed crosses. The oldest ewes in these new lines in 1950 were 4 to 6 years of age.

The estimated annual genetic gain for Targhees from weanling selections from 1944 to 1950 are shown in the following table:

Year	Face covering score	Staple length (cms.)	Weaning weight (lbs.)	Type score	Condition score	Neck folds score
1944	.009	.009	.085	.003	.006	.002
1945	.021	-.001	.095	.004	.010	.002
1946	.008	.013	.115	.003	.006	.001
1947	.026	.017	.156	.002	.010	.001
1948	.027	.007	.127	.002	.003	.001
1949	.031	.019	.235	.005	.014	.002
1950	.029	.005	.137	.003	.008	.001

These rates were less in 1950 than in 1949 for every trait in spite of the slightly shorter generation interval. The decreases may be due to the higher proportions of lambs saved in 1950 and can be counteracted in later selections, particularly for rams. Estimated rates of gain were also less than for Rambouillets for every trait except condition score.

Columbias:

More Columbia lambs of both sexes were saved in 1950 than in 1949. In 1950, 75% of the ram lambs and 76 percent of the ewe lambs were saved as compared with 50% and 69%, respectively, for 1949. A higher proportion of ram lambs were saved in 1944 and of ewe lambs in 1944, 46, 47 and 48 than in 1950.

Selection statistics for Columbia weanling lambs in 1950 are given in the following table:

	Face covering score	Staple length (cms.)	Weaning weight (lbs.)	Type score	Condition score
Heritability	46%	43%	17%	7%	21%
RAMS					
Selection differential	.09	.01	2.14	.07	.09
Expected genetic gain per generation	.021	.002	.182	.002	.009
EWES					
Selection differential	.05	-.06	.91	.04	.04
Expected genetic gain per generation	.012	-.013	.077	.001	.004
RAMS & EWES					
Expected genetic gain per generation	.033	-.011	.259	.003	.013
Selection differentials expressed as fractions of a standard deviation.					
RAMS	.21	.01	.18	.16	.18
EWES	.12	-.08	.08	.09	.08

Selection differentials were lower than in the previous year with the exception of face covering in both sexes and staple length in ram lambs. However, expected genetic gain was again negative for staple length indicating that genetic change from weanling selection is toward shorter staple. Selection differentials were lower in Columbias than in the other 2 breeds with the exception of condition score in Rambouillet ewes. This might be explained by the higher proportion of ram lambs saved and because an index was not used for Columbias while an index was used in weanling selection in the other 2 breeds. There was little difference among the 3 breeds in the proportion of ewe lambs saved.

Neck folds have not been included in the table for Columbias because the incidence of neck folds is so low in this breed that practically no selection can be practiced.

The average age of Columbia sires and dams when their offspring were born are given in the following table:

Year lambs were born	Average age of: Sires (years)	Dams (years)	Sires & Dams (years)
1944	2.55	3.98	3.265
1945	2.87	4.12	3.495
1946	2.83	4.26	3.544
1947	2.62	4.36	3.490
1948	2.30	4.30	3.296
1949	2.38	4.41	3.396
1950	2.32	4.58	3.450

Columbia sires were younger in 1950 than in 1949 or any previous year in the table except 1948. However, Columbia dams have increased in age each year with the exception of 1948 and are now 0.6 year older than in 1944. This may have been due to the introduction of young 2nd cross Columbia ewes into lines in decreasing numbers from 1944 to 1948. There has been no definite trend in generation length in Columbias since 1944 because of the tendency for the increasing age of dams to be counteracted by the decreasing age of the sires. The generation interval for Columbias in 1950 was longer than in either of the other 2 breeds. Also this has been true since 1947.

The estimated annual genetic gain for Columbias from weanling selections from 1944 to 1950 are shown in the following table:

Year	Face covering score	Staple length (cms.)	Weaning weight (lbs.)	Type score	Condition score
1944	.007	.005	.076	.002	.004
1945	.018	.013	.171	.004	.011
1946	.014	-.001	.087	.002	.006
1947	.010	.003	.121	.001	.006
1948	.009	.001	.074	.002	.006
1949	.005	-.001	.158	.003	.009
1950	.010	-.003	.075	.001	.004

These rates were less in 1950 than in 1949 for every trait except face covering. They were also less than the corresponding estimates for the other 2 breeds in every case except condition score of Rambouillets. Selection without an index, the higher proportion of ram lambs saved, and the longer generation interval for Columbias may explain the differences.

THE RELATIVE ACCURACY OF INDIVIDUAL AND COMMITTEE AVERAGE SCORES

Scores on all Rambouillet, Targhee and Columbia lambs (1023 rams and 1080 ewes) weaned in 1950 were analyzed to determine the relative accuracy of individual and committee average scores. Each member of committee A, composed of three men working independently, scored each lamb for face covering, type and neck folds. Each member of committee B, composed of three men working independently, scored each lamb for condition and breech wool (difference in fineness between wool on the side and on the thigh) and measured staple length at the middle of the side. A committee average score for each lamb was obtained by averaging the scores of the three individuals on the committee.

The relative accuracies of the committee average scores and the scores by each of the three individuals were compared. The method used to obtain relative accuracies is based on the assumption that greater scoring accuracy will result in a higher heritability estimate for the trait being scored. Errors in classifying or scoring animals for merit in a trait will contribute to the environmental variance of the scores. Removal of these errors by greater scoring accuracy will increase the heritability of the trait. The amount of increase in heritability is limited by the amount of variance caused by scoring errors. The "true" heritability, which is unknown, represents the upper limit corresponding to 100% accuracy. Thus the accuracy values are relative, not absolute. In this study the half-sib correlation within breed, sex and type of mating pooled over all groups was used as the measure of relative accuracy since it is the basis for an estimate of heritability.

Results obtained indicate that the committee average scores were more accurate than the scores by any one of the three individuals for face covering, neck folds, condition and breech wool. The committee average scores for type and staple length were each surpassed in accuracy by the scores of one individual. When the three traits scored by each committee were considered as a unit, the committee average scores were, on the average, 24% more accurate than the scores by the three individuals on committee A and 29% more accurate than the scores by the three individuals on Committee B. The percentages of increase in accuracy of the committee average scores over the scores by the three individuals were 17%, 17% and 37% respectively, for committee A and 8%, 28% and 51% respectively, for individuals on committee B. The mean differences between scorers were highly significant for each of the six traits studied indicating that the scoring committee should be kept constant at least through one season.

NEW SCORES FOR COARSENESS OF THIGH OR BREECH WOOL

Previous work has shown a trend in average fineness from the smallest average diameter at the withers, shoulder, back and side to larger average diameters at the rump, hip and belly, to the coarsest fibers at the thigh. It has been common practice to cull sheep with obviously coarse thigh wool, particularly if the thigh wool appears to be much coarser than the wool on the side. A method of evaluating this difference between side

and thigh wool is needed to obtain information on the emphasis it should receive in selection. Estimates of heritability, economic importance and relationships to other traits are particularly needed.

New scores were devised in 1950 to evaluate coarseness of breech wool at weaning and yearling age on all sheep and at subsequent ages on all rams. The scoring system was the same as for other traits where lambs having highest merit were given a score of 1 and those of lowest merit a score of 5. Fifteen scoring units were obtained by assigning plus or minus values to lambs having scores slightly above or below the whole unit. Scores given by three independent judges were averaged and rounded off to the nearest scoring unit of 1/3.

A breech wool score of 1 indicated identical fineness (in terms of blood grades) on side and breech. Scores of 2 and 3 indicated small and large amounts, respectively, of wool on the breech one blood grade coarser than wool on the side. Scores of 4 and 5 indicated small and large amounts, respectively of wool on the breech coarser by two blood grades or more.

Fleece and breech grades in spinning counts have been assigned to lamb fleeces at weaning time, to yearling fleeces just before shearing and to mature ram fleeces each year just before shearing. A breech grade score was calculated from the difference in spinning counts between the fleece grade and the breech grade. Only whole units from 1 to 5 were used; a score of 1 indicated the same spinning count, 2 indicated one spinning count coarser on breech than on side, and 5 indicated a difference of 4 spinning counts or more between side and breech.

In addition, breech samples are taken just before shearing on all yearlings and all mature rams to obtain estimates of mean fiber diameter. Comparable fiber diameter determinations are also made on each of these fleeces from blended samples from the shoulder, back and hip. Fleece sorting information and estimates of fleece value will also be studied in relation to breech wool score, breech grade score and mean diameter of breech wool.

Preliminary estimates of heritability of breech wool and breech grade scores have been obtained from weanling lambs in 1950. Results are discussed in the section on heritabilities of weanling lamb traits.

Studies on the relative accuracy of the breech wool and breech grade scores show little difference in the accuracy of the two methods.

RELATION OF FIBER DIAMETER OF THIGH WOOL TO FLEECE TRAITS IN COLUMBIAS AND TARGHEES

A study was made of some previous data to determine the relation of average fiber diameter of thigh wool to average fiber diameter of the whole fleece and to other fleece traits. Average fiber diameter of the whole fleece was determined from blended samples of the shoulder, back and hip. The study involved data from 170 Columbia and 148 Targhee yearling ewes born in 1942 and 1943.

There were highly significant correlations between fiber diameter of the thigh and the whole fleece with correlation coefficients of 0.55 and 0.62 for Columbias and Targhees respectively. Fiber diameter of the thigh wool showed highly significant correlations with variability of fiber diameter of the whole fleece, but these correlations were lower than those between fiber diameter of the whole fleece and variability of fiber diameter of the whole fleece. Partial regression coefficients showed that fiber diameter of the whole fleece had a much higher relationship with variability of fiber diameter of the whole fleece than did the fiber diameter of the thigh wool. Correlations of diameter of thigh wool with grease fleece weight were low but significant (0.18 for Columbias and 0.21 for Targhees) and were very slightly higher than the correlations of whole fleece fiber diameter with grease fleece weight (0.17 for Columbias and 0.20 for Targhees). Correlations of diameter of thigh wool with staple length at the side (0.13 for Columbias and -0.03 for Targhees) were not significant.

Heritability estimates based on half-sib correlations ranged from 0.18 to 0.68 for fiber diameter of thigh wool for the 4 breed and year groups. Three of these 4 estimates were lower than the corresponding estimates of heritability of fiber diameter of the whole fleece.

These results indicate a fairly high relationship of fiber diameter of the thigh to that of the whole fleece. Information on the relation of the fineness of thigh wool to the value of the whole fleece is needed.

HERITABILITIES OF WEANLING LAMB TRAITS

Estimates of heritability were determined for face covering, type, neck folds, staple length, condition, and breech wool score on all weanling lambs (2103) born in 1950 and on fleece grade, breech grade and breech grade score on 1020 weanling lambs born in 1950. Heritabilities were obtained from half-sib intra class correlations within breed, sex and mating type. These heritabilities were averaged over all mating types within breed and sex. Results are shown in the accompanying table.

Highest estimates were obtained for breech grade, face covering, neck folds, fleece grade and staple length in that order. Only the first three had estimates for an individual breed and sex group of over 50%. Estimates were generally low for type and condition scores. Estimates were also generally low for breech wool and breech grade scores with the exception of that for Rambouillet ram lambs.

ESTIMATES OF HERITABILITIES AND STANDARD ERRORS FOR TRAITS OF WEANLING LAMBS

Trait	Rambouillet Herit.	Rambouillet Stand. error	Targhee Herit.	Targhee Stand. error	Columbia Herit.	Columbia Stand. error
RAMS						
d.f. - Between sires	62		27		32	
d.f. - Within sires	416		294		182	
Face Covering	.395**	.040	.189**	.058	.136	.078
Type	.042	.050	.150**	.058	.104	.079
Neck Folds	.589**	.042	.152**	.059	.063	.082
Staple Length	.385**	.041	.240**	.056	.418**	.066
Condition	.233**	.044	.111	.060	.037	.083
Breech Wool score	.207**	.045	-.028	.063	.045	.082
d.f. - Between sires	29		24		32	
d.f. - Within sires	30		246		138	
Fleece Grade	.411	.437	.330**	.066	.286**	.096
Breech Grade	.921**	.272	.334**	.066	.262**	.097
Breech Grade Score	.933**	.267	-.109	.077	-.117	.119
EWES						
d.f. - Between sires	61		27		31	
d.f. - Within sires	455		300		196	
Face Covering	.657**	.033	.383**	.049	.134	.070
Type	.078	.047	.221**	.052	.050	.074
Neck Folds	.044	.048	.020	.057	.003	.076
Staple Length	.204**	.044	.186**	.053	.272**	.065
Condition	.051	.048	.287**	.050	.016	.076
Breech Wool	.106*	.047	.160**	.054	.176**	.069
d.f. - Between sires	25		24		30	
d.f. - Within sires	23		244		155	
Fleece Grade	.433	.528	.328**	.060	.122	.090
Breech Grade	-.007	.593	.528**	.054	.224**	.085
Breech Grade score	-.038	.602	.180**	.065	.092	.092

* Significant at the 5% level.
** Significant at the 1% level.

There were some indications of breed differences in heritability estimates. Rambouillets had highest estimates for both face covering and neck folds followed in order by Targhees and Columbias. Targhees had highest estimates for type score followed in order by Columbias and Rambouillets. Columbias had the highest estimates for staple length followed in order by Rambouillets and Targhees. These apparent differences, although consistent for sex groups, do not necessarily indicate significant breed differences.

Higher estimates of heritability of breech wool score than breech grade score were obtained in 4 of the 6 sex and age groups. However, much higher estimates were obtained for fleece grade and breech grade and these traits may be more helpful additions to the selection index than either of the breech scores. It appears that the uniformity of fleeces may be difficult to improve by selection but that the fineness of various parts of the fleece may be changed more readily. High genetic and phenotypic correlations may exist between the fineness of side and of breech wool which prevent or deter improvements in fleece uniformity.

The large and consistent sex differences in the size of the half-sib correlations for face covering and neck folds indicate a sex difference in the heritability of these traits. Ram lambs had lower heritability of face covering (except for Columbias where both were low) and higher heritability of neck folds than ewe lambs. Ram lambs also had more covered faces, more neck folds and larger standard deviations for both traits with a slightly lower coefficient of variation for face covering. In these data, all of the variation in neck fold scores of ewe lambs appears to be caused by environmental factors. If sex differences in heritability are confirmed by further investigation, present methods for calculating indexes and expected gains from selection may need to be modified. However, it should be pointed out that face covering and neck folds do not follow a normal distribution. It is possible that transformation of the data to normal distributions may remove the sex differences in heritability. If not, the possibility of a genetic-environmental interaction involving sex should be investigated.

RELATIONSHIPS AMONG RAMBOUILLET RAM TRAITS

Additional relationships were obtained during the year which involved clean yield, fiber diameter, variability of fiber diameter, belly wool score, grease fleece weight, clean fleece weight, body weight, staple length, face covering score, neck folds score, type score and condition score on 752 Rambouillet rams born from 1942 to 1948. Relationships involving the first four traits are needed if it is found advisable to include these traits in the selection index. Relationships involving the other traits may be used to increase the accuracy of the present selection index.

Average clean yield, fiber diameter and variability of fiber diameter increased through 3 years of age which was the oldest group studied. There was little change of belly wool score with age.

The highest correlation between traits (0.72 at yearling age) was found between grease fleece weight and clean fleece weight. Clean yield had a positive correlation with clean fleece weight (0.50 at yearling age) and a negative correlation with grease fleece weight (-0.17 at yearling age). Grease fleece weight was nearly twice as important as clean yield in causing variation in yearling clean fleece weight.

Fairly low but significant correlations were found among yearling fiber diameter, variability of fiber diameter and belly wool and for these 3 traits with grease and clean fleece weights. An exception was the non-significant positive correlation of clean fleece weight with variability of fiber diameter. Heavier neck folds were associated with greater fiber diameter and more belly wool. Increased face covering was associated with more belly wool. Relationships among the other traits were very similar to those obtained previously from data on rams born from 1938 to 1942 with some exceptions. The correlations between neck folds and type and condition at yearling age were significantly lower in the present study than in the earlier study when the incidence of neck folds was higher. Correlations between yearling grease fleece weight and body weight with yearling type and condition were significantly higher in the present study than in the earlier study as was the correlation between yearling type and condition scores.

Multiple regression equations were developed to predict yearling grease and clean fleece weight from weanling traits using data on rams born from 1938 to 1942. Of the 6 weanling traits studied, only weanling staple length and body weight were important in predicting yearling fleece weights. Staple length was more important than body weight in predicting clean fleece weight while body weight was more important in predicting grease fleece weight. The multiple correlation coefficient of body weight and staple length with clean fleece weight was 0.65 and with grease fleece weight was 0.63. These multiple correlations are almost as high as the repeatability of staple length from weanling to yearling age and are higher than the repeatabilities of neck folds, type and condition. Thus selection at weanling age on staple length and body weight can be fairly effective in improving yearling fleece weight.

REPEATABILITY OF RAMBOUILLET RAM TRAITS

Repeatabilities on additional traits were obtained during the year. The correlations of one with two year old records were 0.63 for clean yield, 0.56 for fiber diameter, 0.30 for variability of fiber diameter and 0.28 for belly wool. The first 2 are moderately high and the last 2 are fairly low. These values are used to determine the amount of attention to pay to early records and are also used in comparing rams with different numbers of records. Single records are not given much attention with lowly repeatable traits while averages of several records are much more reliable. Single records of highly repeatable traits can be emphasized and averages of several records are not essential for effective selection on these traits.

LAMB PRODUCTION

A summary of lamb production since 1940 for inbred lines in the various breeds is presented in the next table. Targhee and Columbia lines were started in 1940 and offspring were first produced in 1941.

Year	No. of ewes bred	Percent of ewes lambing	Percent lambs born of ewes lambing	Percent of live lambs born of lambs born	Percent of lambs weaned of live lambs born	Percent of lambs weaned of ewes bred	Average weaning weight in pounds	Pounds of lamb per ewe bred
Rambouillet Lines								
1940-44	4489	90.6	127.6	92.9	86.6	91.9	77.7	71.4
1945	898	92.7	124.0	94.4	87.4	93.5	69.5	65.0
1946	890	94.3	134.5	94.6	86.4	100.7	70.8	71.4
1947	897	90.0	124.1	94.6	86.2	88.3	70.6	62.4
1948	882	93.6	130.7	94.9	86.2	98.8	66.3	65.4
1949	1002	90.4	128.4	93.2	81.1	86.1	69.5	59.8
1945-49	4569	92.2	128.0	94.3	85.4	93.3	69.3	64.7
1950	851	89.1	119.6	94.5	79.6	76.0	70.5	53.6
Targhee Lines								
1941-44	800	92.2	128.7	93.6	78.9	86.5	72.6	62.8
1945	257	88.4	127.9	96.1	84.4	84.4	71.7	60.5
1946	245	95.8	130.6	96.0	76.3	89.4	72.1	64.4
1947	299	93.2	118.9	91.4	78.6	78.6	74.6	58.6
1948	288	92.2	127.1	90.7	83.1	87.2	72.5	63.2
1949	408	88.6	122.5	96.0	81.8	82.8	77.6	64.3
1945-49	1497	91.4	124.9	94.1	80.0	84.2	74.0	62.3
1950	420	95.2	128.1	92.5	85.0	94.8	73.8	70.0
Columbia Lines								
1941-44	1294	86.7	126.0	90.7	80.5	78.0	78.5	61.3
1945	378	90.7	128.5	93.5	78.5	83.1	73.0	60.6
1946	448	89.4	130.9	90.6	68.7	70.5	72.6	51.2
1947	455	82.7	118.7	79.6	74.6	56.9	76.0	43.2
1948	320	88.3	124.6	85.7	80.3	75.0	74.3	55.8
1949	381	88.9	126.1	90.1	73.5	72.2	80.0	57.7
1945-49	1982	87.8	125.9	88.0	74.7	70.8	75.0	53.2
1950	343	87.2	127.7	91.2	80.6	79.9	76.6	61.2

The percent of ewes lambing is based on ewes bred and present at lambing. This percent may be an indication of ram fertility. The percent of lambs born of ewes lambing is based on all lambs born, alive or dead, of ewes actually having lambs. This value minus 100 gives the percent of ewes having twins. The percent of lambs born which were alive and the percent of live lambs which are weaned are measures of lamb mortality at birth and from birth to weaning, respectively. The percent of lambs weaned of ewes bred is a combination of the first four values plus any effect of ewe loss after breeding. Weaning weights are taken when it is necessary to remove ram lambs to prevent them from breeding ewes which is somewhat earlier than costomary market time. Average age at weaning has decreased in recent years because of slight changes in breeding and weaning dates. The average weaning ages in 1950 were 122, 113 and 115 days for Rambouillets, Targhees and Columbias, respectively. Pounds of lamb per ewe bred is an overall value that is a combination of the other individual measures. Breeds are not directly comparable because of differences in age of ewes, breeding and weaning dates, etc.. Some changes in age of ewes, breeding and weaning dates, etc. occur from year to year.

In 1950 Rambouillets were lower than in past years in percent of ewes lambing, percent of lambs born and percent of lambs weaned. This may have been largely due to the use of ewes 3 years old and older for crossing of lines thus leaving a higher proportion than normal of 2-year old ewes in lines.

Targhees showed improvement in 1950 over averages of past years in percent of ewes lambing and in percent of lambs weaned. In 1950 Columbias showed improvement over averages of past years in percent of lambs born, percent lambs born alive and in percent of lambs weaned.

REPEATABILITY OF LAMB PRODUCTION IN RAMBOUILLET EWES

A study was made of repeatability of lamb production in Rambouillet ewes born from 1938 to 1942. Only ewes weaning single lambs as 2-year olds were included. The correlations of the unadjusted weight of a single lamb weaned by 2-year-old ewes with pounds of lamb weaned as 3, 4, 5 and 6-year-old ewes were 0.16, 0.21, 0.12 and 0.06 respectively. Correlations of pounds of lamb weaned by 3-year-old ewes with that by 4, 5 and 6-year-old ewes were 0.09, 0.12 and 0.17, respectively and for 4-year-old ewes with 5 and 6-year-old ewes was 0.20 and 0.18 and for 5 with 6-year-old ewes was 0.24. All correlations were significant except that of 2 with 6-year-old ewes. These values indicate that the repeatability of pounds of lamb weaned is significant but low and that selection on any single year's record would not be very reliable. This study is being extended to include Rambouillet ewes born in these years that did not wean single lambs as 2-year olds.

RAM SEMEN TESTS FOR 1950

The semen of 219 rams (lambs, yearlings and matures) was examined before the beginning of the 1950 breeding season. The following table shows that 182 of these were considered to have semen of acceptable quality, i.e. the rams were considered to be potentially highly fertile, after the first test (3 consecutive ejaculates). Thirty-seven had semen ranging from doubtful to definitely poor quality. Seventeen of these 37 rams were retested after which 6 were considered to be potentially fertile and 11 were considered to be poor breeding risks. The other 20 rams were not retested either because they were not needed for breeding or because their semen was of such poor quality on the first test that further tests appeared to be useless. Nine rams of yearling age or older and 30 lambs refused to serve ewes under the conditions that prevailed and consequently their semen was not examined nor were they used in breeding.

On the basis of all rams tried, 79.4% of those 2 years old and older had semen of acceptable quality, 19.0% had semen of borderline to definitely poor quality and 1.6% refused to serve. The corresponding percentages were 79.9, 14.2 and 5.9 for 134 yearling rams and 41.0, 9.8 and 49.2 for 61 ram lambs.

No striking breed differences or breed x age interactions were apparent and it would appear that if such differences really exist, much larger numbers of rams will be required to establish them. The slightly higher percentage of yearling rams with semen of acceptable quality (on the basis of rams whose semen was examined) is in agreement with the findings of previous studies of individual semen characteristics.

		First Test							Second Test				
					Rams having semen of:					Rams having semen of:			
Age	No. of rams tried	Rams refusing to serve		No. rams tested	Acceptable quality		Borderline to definitely poor quality		No. rams tested	Acceptable quality		Borderline to definitely poor quality	
		No.	%		No.	%	No.	%		No.	%	No.	%
2 yrs. and over	63	1	1.6	62	50	80.6	12	19.4	6	0	0.0	6	100.0
1	134	8	5.9	126	107	84.9	19	15.1	10	5	50.0	5	50.0
Lambs	61	30	49.2	31	25	80.6	6	19.4	1	1	100.0	0	--
Total	258	39	15.1	219	182	83.1	37	16.9	17	6	35.3	11	64.7

RELATIONSHIPS BETWEEN LIBIDO, SEMEN CHARACTERISTICS AND FERTILITY OF RANGE RAMS

The relationships between libido, semen characteristics, and breeding records of Rambouillet, Columbia, and Targhee rams, mated in 423 pens over a 4 year period (1946-49), were studied.

During the 4 years there were 6 pens (1.42%) in which no ewes lambed and 101 pens (23.88%) in which all ewes lambed. About 68% of the pens had a lambing percentage of 90 or higher, and 89% had a lambing percentage of 80 or higher. The average percentage of ewes lambing per pen was 89.40.

The data indicated that libido, as measured by the time required to produce successive ejaculates and by the number of ejaculates produced in a 30-minute period, had no important relationship to fertility.

Of the various semen characteristics studied (including viscosity, pH, motility score, percentage of motile sperm, estimated motility count or EMC, volume of semen, sperm concentration, and total sperm produced) only viscosity, EMC, and motility score were significantly correlated with percentage of ewes lambing. However, viscosity and EMC were found not to be significantly associated with fertility when motility score was held constant by use of the partial-correlation technique.

Motility score was significantly related to percentage of live lambs and its correlation with percentage of lambs weaned approached significance. However, these correlations appear to result from the significant relationship of percentages of live lambs and of lambs weaned with percentage of ewes lambing.

It should be borne in mind however, that the practice of discarding almost all rams with semen of questionable quality would tend to obscure real relationships between various semen characteristics and fertility of the rams. Therefore, failure to find significant relationships between some of the commonly accepted measures of semen quality and fertility does not necessarily mean that such relationships do not exist.

BIRTH COAT STUDY

All live lambs born in the spring of 1950 were scored at time of birth for the amount of hair in the fleece, and for the amount of wool covering. Numerical scores and their definitions are as follows:

Scores for Amount of Hair in Fleece at Birth

Score No.

1. No hair: Completely free of any hair-like fibers.
2. Slight hair: Very few hair-like fibers on various areas of lamb.
3. Medium hair: Hair-like fibers appearing throughout the cover or dense hair-like fibers on various areas of lamb.
4. Considerable hair: Long hair-like fibers of medium density throughout the cover.
5. Extreme hair: Fully covered with long dense hair-like fibers.

Scores for Wool Covering of Lambs at Birth

1. Very slight wool covering: Partially covered with very short wool, considerable pink skin showing.
2. Slight wool covering: Thin, slight covering of short wool.
3. Medium wool covering: Wool covering of thin to medium density.
4. Considerable wool covering: Wool staple formation, medium to heavy density.
5. Heavy wool Covering: Long staple, heavy density.

All lambs were again observed at weaning age for length of staple and grade of fleece on side and thigh. Yearling fleeces were graded in numerical spinning count, both on side and thigh, and measured for staple length just before shearing in May 1951. The fleeces from all the yearling ewes and rams were individually sorted. Fleece weight, staple length, and the amount and grade of each sort from each fleece will be analysed in relation to the scores for hairy coat and wool covering at birth.

Distributions of lambs at birth and at weaning with the various scores for hair and wool covering are presented in the accompanying table.

Birth Coat Scores and Their Relationship to Survival Rates

	Rambouillet					Targhee					Columbia				
Hair score	No. born	% of all lambs born	No. weaned	% weaned of all lambs weaned	% weaned of lambs born	No. born	% of all lambs born	No. weaned	% weaned of all lambs weaned	% weaned of lambs born	No. born	% of all lambs born	No. weaned	% weaned of all lambs born	% weaned of lambs born
1	261	21.0	213	20.7	81.6	121	17.8	102	17.5	84.3	80	16.5	63	16.2	78.8
2	737	59.2	617	59.8	83.7	440	64.8	379	64.9	86.1	313	64.7	253	64.8	80.8
3	203	16.3	165	16.0	81.3	93	13.7	84	14.4	90.3	73	15.1	58	14.9	79.4
4	43	3.4	35	3.4	81.4	21	3.1	15	2.6	71.4	13	2.7	11	2.8	84.6
5	1	0.1	1	0.1	100.0	4	0.6	4	0.7	100.0	5	1.0	5	1.3	100.0
TOTAL	1245		1031		82.8	679		584		86.0	484		390		80.6
Wool cov. score															
1	37	3.0	29	2.8	78.4	1	0.2								
2	978	78.6	797	77.3	81.5	408	60.1	343	58.7	84.1	172	35.5	133	34.1	77.3
3	228	18.3	204	19.8	89.5	256	37.7	230	39.4	89.8	267	55.2	213	54.6	79.8
4	2	0.2	1	0.1	50.0	12	1.8	9	1.5	75.0	42	8.7	41	10.5	97.6
5	0		0			2	0.3	2	0.3	100.0	3	0.6	3	0.8	100.0
TOTAL	1245		1031		82.8	679		584		86.0	484		390		80.6

The average hair and wool covering scores were 2.03 and 2.16, 2.04 and 2.42, and 2.07 and 2.74, respectively, for Rambouillets, Targhees and Columbias. These are consistent in that the breeds with longer staple and coarser fleeces tend to have more hair and more wool covering at birth. However, differences for hair covering were very slight.

Lambs receiving larger scores for hair at birth also tended to receive larger scores for wool covering at birth. This is shown by significant correlations between hair score and wool covering score of 0.24, 0.41 and 0.29 for Rambouillets, Targhees and Columbias, respectively.

Lambs with hair (scores 2 to 5) tended to survive slightly better to weaning age than lambs without hair (score 1). The percentage of lambs with hair which were weaned was 86.3, 86.0 and 80.6 for Rambouillets, Targhees and Columbias, respectively, as compared with 81.6, 84.3 and 78.8 for corresponging groups of lambs without hair. However, these differences were not significant.

A higher percentage of lambs with good wool covering at birth survived to weaning age than lambs with poor wool covering. Survival, in terms of percentage of lambs weaned of those scored at birth, for all 3 breeds combined, was 76.3, 81.7, 86.2, 91.1 and 100 for wool covering scores of 1 to 5, respectively. These differences were significant at the 5 percent level. It is not known how much of the survival advantage indicated is due to differences in birth coat. Differences in the gestation period, that is, maturity of the lamb at birth may have had some influence on birth coat as well as on other qualities that affect survival.

FLEECE GRADES OF 1950 CLIP

Grades have been assigned to whole fleeces at shearing time since 1942. It is probable that grading standards have not been constant during this time. Present standards place fleeces with spinning counts or U. S. numerical grades of 64's and finer with staple length of 2 1/2 inches or more in Fine Staple and those of the same counts under 2 1/2 inches in Fine French. One-half Blood staple includes counts of 60's with 3-inch length up to 1949 and 2 1/2 inches beginning in 1950. Three-eights Blood includes counts of 56's and 58's with 3 inches required for staple length. Grades of 1/2 Blood French and 3/8 Blood French were assigned to a few fleeces in 1950 but not in other years so they have not been shown separately in the tables. Counts of 48's and 50's are included in 1/4 Blood, 46's in Low 1/4 Blood, 44's in Common and 40's and 36's in Braid.

Grades based on mean fiber diameter were obtained from cross sections of blended samples from the shoulder, back and hip. These have generally been obtained from all rams and all yearling ewes. However, data are incomplete for some past years. Approximately 1400 cross-section determinations of fiber diameter, uniformity and percent medullation were

made in 1950-51. The conversion of mean fiber diameter to grades is shown in the following table:

Blood Grade	U. S. Numerical Grade	Range in Mean Diameter (Microns)
Fine	80's	18.0 to 19.5
	70's	19.6 to 21.0
	64's	21.1 to 22.5
1/2 Blood	62's	22.6 to 24.0
	60's	24.1 to 25.5
3/8 Blood	58's	25.6 to 27.0
	56's	27.1 to 29.0
1/4 Blood	50's	29.1 to 31.5
	48's	31.6 to 33.2
Low 1/4 Blood	46's	33.3 to 34.7
Common	44's	34.8 to 36.5
Braid	40's	36.6 to 38.7
	36's	38.8 to 41.3

The accompanying tables show the percentage distributions of grades based on visual grading of whole fleeces at shearing time and those based on cross-section fiber diameter.

Rambouillets:

Distributions of fleece grades at shearing show, in general, that a higher proportion of fleeces were graded 1/2 Blood in the last two years. However, grades based on fiber diameter generally show a higher proportion grading Fine in the last two years, particularly in 1950, than in previous years. The average fiber diameter from cross sections for Rambouillets since 1943, as shown in the next table, do not show any definite trend.

	Average diameter in microns							
	1943	1944	1945	1946	1947	1948	1949	1950
Yearling ewes	20.28	20.57	21.53	21.48	21.01	21.98	21.75	21.46
Mature rams	22.68	23.36	23.91	23.12	23.56	23.24	23.08	22.51
Yearling rams	21.94	21.55	21.28	21.06	20.87	21.70	21.21	21.64

GRADES OF RAMBOUILLET FLEECES

	Distribution of Grades Based on Visual Grading at shearing time								
	Years								
	1942	1943	1944	1945	1946	1947	1948	1949	1950
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Mature ewes									
Fine French	70	39	36	39	19	34	40	43	30
Fine Staple	29	58	61	58	75	65	54	50	57
1/2 Blood	1	3	3	3	6	1	6	7	13
Yearling ewes									
Fine French	41	6	4	28	3	9	2	4	12
Fine Staple	58	88	92	66	91	88	91	90	76
1/2 Blood	1	6	4	6	6	3	7	6	12
Mature rams									
Fine French	15	7	3	2	4	2		10	5
Fine Staple	83	93	97	98	96	98	100	37	76
1/2 Blood	2							53	18
Yearling rams									
Fine French	11	6	2	2	7	9		6	5
Fine Staple	85	92	98	97	93	91	97	85	79
1/2 Blood	4	2		1			3	9	16

Distribution of Grades based on Cross-Section Fiber Diameter

Yearling ewes								
Fine	91	92	78	78	84	62	77	93
1/2 Blood	9	8	21	20	16	36	22	7
3/8 Blood			1	2		2	1	
Mature rams								
Fine	57	25	27	36	31	34	44	62
1/2 Blood	31	65	51	57	60	51	51	37
3/8 Blood	11	10	20	6	8	14	5	1
1/4 Blood	1		2	1	1			
Yearling rams								
Fine	69	87	83	86	83	71	96	94
1/2 Blood	25	12	17	14	17	20	4	6
3/8 Blood	6	1				9		

Average fiber diameters were smaller in 1949 and 1950 than in 1948 but were not smaller than those for a majority of the previous years except for mature rams.

In general, fleece grades based on cross sections tend to be coarser than those based on visual grading. Exceptions were yearling ewes in 1950 and yearling rams in 1949 and 1950.

In a majority of the years visual grades showed yearling ewes to have the coarsest fleeces followed by mature ewes, yearling rams and mature rams in that order. However, in 1950 the order from coarse to fine by visual grading was mature rams, yearling rams, mature ewes and yearling ewes. Grading based on cross sections showed mature rams with coarsest fleeces followed by yearling ewes and yearling rams in that order in a majority of the years.

Targhees:

In 1949 and 1950, a higher proportion of Targhee fleeces were placed in the coarser grades from visual grading of whole fleeces at shearing than in previous years, with the exception of yearling rams in 1949. This tendency was not so evident in distributions based on cross-section fiber diameter. Average fiber diameters for Targhees since 1943, as shown in the following table, do not show any definite trend in fineness:

	Average diameter in microns							
	1943	1944	1945	1946	1947	1948	1949	1950
Yearling ewes	23.22	23.26	24.17	24.48	22.34	24.12	23.66	23.56
Mature rams	25.79	27.49	--	27.21	--	24.77	25.65	26.45
Yearling rams	24.51	24.39	--	22.48	--	23.70	22.79	23.05

In general, grades based on cross sections show finer fleeces for yearling ewes and rams and coarser fleeces for mature rams than do visual grades at shearing time.

Sex and age groups rank from coarse to fine in the order of yearling ewes, mature rams, mature ewes and yearling rams in a majority of the years on visual grading at shearing. Grades based on cross sections rank mature rams, yearling ewes and yearling rams in order from coarse to fine in a majority of the years.

GRADES OF TARGHEE FLEECES

	Distribution of Grades Based on Visual Grading at Shearing Time								
	Years								
	1942 (%)	1943 (%)	1944 (%)	1945 (%)	1946 (%)	1947 (%)	1948 (%)	1949 (%)	1950 (%)
Mature Ewes									
Fine French	2		2	4	4	4	5	2	1
Fine Staple	5	10	18	11	13	12	21	6	4
1/2 Blood	91	80	72	75	70	68	63	54	54
3/8 Blood	2	10	7	10	11	15	11	38	39
1/4 Blood			1		2	1		1	2
Yearling Ewes									
Fine French						2			1
Fine Staple	2	2	14	9	8	19	16	12	16
1/2 Blood	82	83	75	79	76	64	73	46	61
3/8 Blood	16	15	11	11	16	14	9	40	21
1/4 Blood				1		1	2	2	1
Mature Rams									
Fine French					3				
Fine Staple			6	9	6	9	8		2
1/2 Blood	97	92	88	76	71	73	77	43	44
3/8 Blood	3	4	6	15	20	14	15	57	52
1/4 Blood		4				4			2
Yearling Rams									
Fine French							3		
Fine Staple	2		14	10	8	12	27	13	4
1/2 Blood	98	62	72	72	81	64	60	75	51
3/8 Blood		38	14	18	11	22	10	11	44
1/4 Blood						2		1	1
	Distribution of Grades Based on Cross-Section Fiber Diameter								
Yearling Ewes									
Fine		33	34	5	1	61	19	26	15
1/2 Blood		63	54	81	82	38	59	62	80
3/8 Blood		4	12	14	17	1	21	12	5
1/4 Blood							1		
Mature Rams									
Fine		8			6		18		
1/2 Blood		42	6		26		49	45	32
3/8 Blood		46	79		40		24	53	61
1/4 Blood		4	15		28		9	2	7
Yearling Rams									
Fine		5	7		56		37	46	40
1/2 Blood		76	68		36		49	53	59
3/8 Blood		19	25		8		10	1	1
1/4 Blood							4		

Columbias:

A higher proportion of Columbia yearling ram and ewe fleeces were placed in the finer grades on the basis of visual grading in 1949 and 1950 than in most of the previous years and a similar trend was evident for distributions of grades based on fiber diameter. This trend was less evident for mature rams and ewes. Mean fiber diameters, as shown in the following table, were also smaller in 1949 and 1950 than in most of the previous years for all groups:

	Average diameter in microns							
	1943	1944	1945	1946	1947	1948	1949	1950
Yearling ewes	27.16	25.88	26.61	26.88	--	27.02	25.67	25.16
Mature rams	29.05	30.24	--	29.65	--	30.39	28.92	29.39
Yearling rams	27.74	27.39	--	25.62	--	26.59	25.81	25.65

In general, grades based on cross sections show finer fleeces for yearling ewes and rams and coarser fleeces for mature rams than do visual grades at shearing time. This is consistent with results for Targhees.

In a majority of the years sex and age groups were ranked from coarse to fine by visual grading in the order of mature rams, mature ewes, yearling rams and yearling ewes. Ranks based on cross sections were in the order of mature rams, yearling rams and yearling ewes.

GRADES OF COLUMBIA FLEECES

	Distribution of Grades based on Visual Grading at Shearing Time								
	Years								
	1942 (%)	1943 (%)	1944 (%)	1945 (%)	1946 (%)	1947 (%)	1948 (%)	1949 (%)	1950 (%)
Mature Ewes									
1/2 Blood	12	3	6	3	3	3	3	4	3
3/8 Blood	53	58	55	48	47	47	45	42	48
1/4 Blood	32	37	37	48	48	48	46	50	41
Low 1/4 Blood	3	2	2	1	2	2	6	4	8
Yearling Ewes									
1/2 Blood	7	3	7	4	4	6	7	9	19
3/8 Blood	75	61	72	57	42	63	67	70	70
1/4 Blood	18	35	20	39	53	30	25	19	11
Low 1/4 Blood		1	1			1	1	2	
Mature Rams									
1/2 Blood	2		4	3		3			
3/8 Blood	61	52	74	47	26	40	50	61	52
1/4 Blood	37	48	22	50	74	55	46	39	33
Low 1/4 Blood						2	4		14
Com. & Braid									1
Yearling Rams									
Fine Staple					1				
1/2 Blood			9	8	5	3	5	11	2
3/8 Blood	80	48	65	53	57	56	72	77	85
1/4 Blood	20	48	26	38	37	40	23	11	13
Low 1/4 Blood		4		1		1		1	
	Distribution of Grades Based on Cross-Section Fiber Diameter								
Yearling Ewes									
Fine		2	4				3	2	
1/2 Blood		15	36	16	4		26	38	62
3/8 Blood		72	55	84	93		52	57	38
1/4 Blood		10	5		3		18	3	
Low 1/4 Blood		1					1		
Mature Rams									
Fine		3							
1/2 Blood		6					4		2
3/8 Blood		43	30		40		23	51	35
1/4 Blood		36	59		55		60	49	63
Low 1/4 Blood		12	11		5		4		
Com. & Braid							9		
Yearling Rams									
Fine					6		2	2	1
1/2 Blood		24	14		40		28	35	43
3/8 Blood		62	75		51		56	62	54
1/4 Blood		9	9		3		14	1	2
Low 1/4 Blood		5	2						

SUMMARY OF 1950 GREASE FLEECE WEIGHTS BY GRADE

Grade	Mature Ewes						Yearling Ewes					
	Rambouillet		Targhee		Columbia		Rambouillet		Targhee		Columbia	
	No.	Ave. wt. (lbs.)	No.	Ave. wt. (lbs.)	No.	Ave. wt. (lbs.)	No.	Ave. wt. (lbs.)	No.	Ave. wt. (lbs.)	No.	Ave. wt. (lbs.)
FF	369	8.77	8	8.61			47	7.57	1	7.80		
FS	684	9.07	22	9.00	1	8.10	295	8.45	24	8.82		
1/2F	31	9.44	19	8.95	1	6.70						
1/2S	122	9.55	307	9.75	16	9.00	45	8.78	93	8.83	28	9.24
3/8F	3	10.57	8	10.86	9	8.50					1	9.20
3/8S	1	11.90	226	10.83	256	9.76			33	9.81	100	9.34
50's			10	11.83	151	10.86			1	9.80	16	10.39
48's			1	12.30	75	11.31						
46's			1	11.00	39	11.44						
44's					7	11.34						
ALL	1210	9.04	602	10.14	555	10.35	387	8.38	152	9.04	145	9.44

	Mature Rams						Yearling Rams					
FF	6	12.35					7	9.37				
FS	87	14.16	1	14.70			121	10.69	4	11.35		
1/2F			1	15.00								
1/2S	21	16.04	23	14.83			25	11.04	47	10.85	2	11.20
3/8F												
3/8S	1	14.10	28	16.18	24	15.57			40	12.14	90	11.87
50's			1	19.60	8	16.38			1	12.70	14	12.62
48's					7	16.73						
46's					7	18.63						
44's												
ALL	115	14.41	54	15.62	46	16.35	153	10.69	92	11.45	106	11.96

RELATIVE VALUES OF VARIOUS COMMERCIAL GRADES OF FLEECES

Relative values of various commercial grades of Rambouillet, Targhee and Columbia fleeces shorn in 1950 were calculated by the following procedure:

Fleeces were grouped within breed, age and sex on the basis of the grade placed on the whole fleece at shearing time. For ewes, the average weight of clean wool was estimated from the average grease weight of each fleece grade multiplied by the clean yield of the corresponding matching sort. These clean yields were obtained from commercial scouring of matchings which included wool from all breeds, ages and sexes. For example, the average grease weight of Fine Staple Rambouillet mature ewe fleeces was multiplied by the commercial clean yield of all Fine Staple wool obtained from sorting individual fleeces. For rams, the same procedure was followed except that clean yield was based on the average yield of side samples from all ram fleeces in each group. The average clean weights per fleece were then multiplied by each of the following three sets of prices per pound of clean wool to obtain relative values of the various grades of fleeces:

A. Appraised prices of sorted lots (matchings) from the 1950 Station clip. These lots included wool from all breeds, ages and sexes and were appraised October 23, 1950.

B. Average prices per pound, clean basis, Boston, for the various grades during 1950 as reported by the Bureau of Agricultural Economics.

C. Weighted average of yearly average prices from the same source as B for 1941 through 1950 with the last five years receiving twice as much weight as the first five years.

It is obvious that the values obtained are not actual values because all of the wool in fleeces grading Fine Staple, for example, would not qualify as Fine Staple matchings due to the presence of some offsort wool and probably some wool of different length and fineness. Therefore, the values obtained are relative and provide only rough estimates. More accurate estimates of fleece values will be calculated as soon as more detailed information becomes available.

The clean yields from side-samples and from commercial scouring are based on 14% moisture in the clean wool. Clean yields from side-samples of ram fleeces were unusually high in 1950. Differences between commercial clean yields of fine and coarse wools appeared to be somewhat smaller than those obtained in previous years. The tendency observed in previous years for the coarser fleeces to be generally more valuable than finer fleeces is not apparent in the 1950 data.

Results shown in the accompanying table indicate that length of staple has an important effect on fleece value. In all groups, fleeces

AVERAGE FLEECE VALUES BY GRADES[1]

Age and sex	Fleece grade	Rambouillet				Targhee				Columbia			
		No.	Ave. fleece value in $ A	B	C	No.	Ave. fleece value in $ A	B	C	No.	Ave. fleece value in $ A	B	C
Yearling Ewes	FF	47	7.85	6.61	4.65								
	FS	295	9.84	8.17	5.73	24	10.27	8.53	5.98				
	1/2S	45	10.01	7.93	5.75	93	10.08	7.98	5.79	28	10.53	8.34	6.05
	3/8S					33	9.18	7.49	5.44	100	8.75	7.14	5.19
	50's									16	9.31	7.57	5.68
Mature Ewes	FF	369	9.09	7.65	5.39	8	8.93	7.52	5.29				
	FS	684	10.56	8.76	6.15	22	10.46	8.69	6.10				
	1/2F	31	8.72	7.88	5.90	19	8.26	7.48	5.60				
	1/2S	122	10.89	8.62	6.26	307	11.12	8.80	6.39	16	10.26	8.13	5.90
	3/8F					8	8.82	6.41	5.26	9	6.90	5.01	4.12
	3/8S					226	10.14	8.27	6.01	256	9.14	7.46	5.42
	50's					9	10.59	8.62	6.46	151	9.74	7.92	5.94
	48's									75	9.63	8.62	6.46
	46's									39	9.20	7.63	6.01
	40's & 44's									7	9.11	7.22	5.72
Yearling Rams	FF	7	12.71	10.70	7.53								
	FS	121	15.14	12.57	8.82								
	1/2S	24	14.83	11.74	8.52	47	14.08	11.16	8.09				
	3/8S					40	13.14	10.72	7.79	89	12.38	10.10	7.34
	50's									14	12.24	9.97	7.47
Mature Rams	FF	6	16.09	13.53	9.53								
	FS	87	20.57	17.07	11.98								
	1/2S	21	21.98	17.41	12.63	23	19.22	15.22	11.04				
	3/8S					28	17.74	14.48	10.52	24	18.09	14.77	10.73
	50's									8	16.98	13.82	10.36
	48's									7	15.28	13.69	10.26
	46's									7	17.68	14.68	11.56

1. These are relative, not actual, fleece values. See text for method of calculation.

with short staple length (those classified as "French" for their grade) have the lowest value. On the basis of the clean yields and prices used, fleece fineness appears to have a less important effect on fleece value than length. In general, among fleeces of "Staple" length there are relatively small differences in fleece value between the different fineness grades. The ten-year average prices (C) place less premium on the finer grades than do the two sets of 1950 prices (A & B) with the result that the coarser grades are relatively more valuable under the former set of prices.

Rambouillets:

Among Rambouillets, 1/2 Blood Staple fleeces were most valuable under all three sets of prices for mature rams and under two of the price sets for yearling ewes and mature ewes. Fine Staple fleeces were most valuable for yearling rams in all cases.

Targhees:

Among Targhees, 1/2 Blood Staple fleeces were most valuable under all price sets for yearling rams and mature rams and under two of the price sets for mature ewes. Fine Staple fleeces were most valuable for yearling ewes in all cases.

Columbias:

Among Columbias, 1/2 Blood Staple fleeces were most valuable under all three price sets for yearling ewes, and 3/8 Blood Staple fleeces were most valuable in two of the three cases for mature rams and yearling rams. For the latter, fleeces grading 46's were most valuable in one case and second most valuable in two cases. For mature ewes, fleeces grading 48's were most valuable under two of the price sets and 1/2 Blood Staple fleeces were most valuable under the third price set. Under all three price sets, mature ewe fleeces grading 3/8 Blood Staple were exceeded in value by those grading 1/2 Staple, 50's, 48's and 46's.

SORTING OF INDIVIDUAL FLEECES IN 1950

The fleeces from 3,080 ewes and 568 rams were sorted individually in 1950 by one commercial wool sorter from The Wool Division with the assistance of a Bureau employee. The matchings and off-sorts from each fleece were individually weighed, recorded and binned according to grade and staple length. Fleeces of mature ewes and rams represent one year's growth. Fleeces of yearling ewes and rams had an average growth period of about 410 days.

All mature ewes were crutched in February prior to shearing in May. Approximately 1/2 pound of wool was clipped from each ewe. This wool was not included with the fleece weights; therefore, the grease fleece weight for each mature ewe is approximately 1/2 pound lighter than the actual wool produced for the year. The high shrinkage of the fine crutchings was due to mud conditions in the feed lot. Value per grease pound of fine crutchings, Dubois, was $0.48 or $0.255 per head. Value per grease pound of Cross-bred crutchings, Dubois, was $0.64, or $0.314 per head.

Some data from the sorting, summarized by breed and age groups are presented in the accompanying tables. In general, mature sheep had

1950 WOOL SORTING SUMMARY

Rambouillet Ewes

Description	Yearling Ewes: No. of fleeces contributing	Yearling Ewes: Ave. wt. per fl. contributing	Yearling Ewes: % of total weight sorted	Yearling Ewes: Total weight sorted	Mature Ewes: No. of fleeces contributing	Mature Ewes: Ave. wt. per fl. contributing	Mature Ewes: % of total weight sorted	Mature Ewes: Total weight sorted
Matchings								
64's and Finer								
Fine Staple	365	5.56	63.12	2,029.6	1045	5.48	53.29	5,726.0
Fine French	204	1.81	11.46	368.5	774	3.76	27.11	2,912.7
60's and 62's								
1/2 Staple	124	1.85	7.14	229.6	152	2.67	3.77	405.3
1/2 French	117	.67	2.44	78.4	717	.97	6.47	695.3
56's and 58's								
3/8 Staple					2	2.10	0.04	4.2
3/8 French	12	.36	0.13	4.3	144	.59	0.79	85.3
50's					1	.90	0.00	0.9
Total Matchings	386	7.02	84.30	2,710.4	1208	8.14	91.47	9,829.7
Off-Sorts								
Seedy	376	.66	7.69	247.4	1162	.64	6.88	738.94
Stained	360	.44	4.97	159.7	586	.28	1.51	161.95
Tags	300	.33	3.04	97.7	132	.11	0.31	14.30
Total Off-sorts	386	1.31	15.70	504.8	1208	.76	8.52	915.19
TOTAL SORTED	386	8.33	100.00	3,215.2	1208	8.90	99.99	10,744.89

1950 WOOL SORTING SUMMARY

Rambouillet Rams

Description	Yearling Rams: No. of fleeces contributing	Yearling Rams: Ave. wt. per fl. contributing	Yearling Rams: % of total weight sorted	Yearling Rams: Total weight sorted	Mature Rams: No. of fleeces contributing	Mature Rams: Ave. Wt. per fl. contributing	Mature Rams: % of total weight sorted	Mature Rams: Total weight sorted
Matchings								
64's and Finer								
Fine Staple	151	8.80	81.09	1,328.2	105	10.88	71.97	1,142.7
Fine French	32	1.13	2.20	36.0	27	3.07	5.23	83.0
60's and 62's								
1/2 Staple	50	1.30	3.98	65.2	41	3.45	8.90	141.3
1/2 French	15	.58	0.53	8.7	19	.84	1.00	15.9
56's and 58's								
3/8 Staple					1	.50	0.03	0.5
3/8 French	16	.37	0.36	5.9	17	1.43	1.53	24.3
Total Matchings	153	9.44	88.16	1,444.0	110	12.80	88.66	1,407.7
Off-Sorts								
Seedy	149	1.01	9.22	150.95	105	.87	5.78	91.84
Stained	107	.38	2.51	41.15	100	.82	5.15	81.75
Tags	18	.10	0.10	1.75	40	.16	0.40	6.35
Total Off-sorts	153	1.27	11.83	193.85	110	1.64	11.33	179.94
TOTAL SORTED	153	10.70	99.99	1,637.85	110	14.43	99.99	1,587.64

1950 WOOL SORTING SUMMARY

Targhee Ewes

Description	Yearling Ewes: No. of fleeces contributing	Yearling Ewes: Ave. wt. per fl. contributing	Yearling Ewes: % of total weight sorted	Yearling Ewes: Total weight sorted	Mature Ewes: No. of fleeces contributing	Mature Ewes: Ave. Wt. per fl. contributing	Mature Ewes: % of total weight sorted	Mature Ewes: Total weight sorted
Matchings								
64's and Finer								
Fine Staple	51	4.93	18.18	251.5	138	5.47	12.28	754.2
Fine French	15	.83	0.90	12.4	27	2.77	1.22	74.7
60's and 62's								
1/2 Staple	130	5.49	51.74	713.8	372	5.85	35.41	2,174.6
1/2 French	35	1.83	4.65	64.0	80	1.81	2.36	144.7
56's and 58's								
3/8 Staple	43	2.58	8.06	111.1	295	5.51	26.45	1,624.5
3/8 French	48	1.24	4.31	59.4	228	1.92	7.12	437.5
50's	14	.63	0.64	8.8	226	1.48	5.43	333.4
48's	1	.30	0.02	0.3	63	1.02	1.05	64.4
46's					7	.38	0.05	2.9
44's					3	.23	0.01	.7
Total Matchings	152	8.03	88.66	1,221.3	615	9.12	91.38	5,611.6
Off-Sorts								
Seedy	125	.56	5.09	70.17	599	.79	7.68	471.40
Stained	147	.49	5.20	71.57	206	.18	0.62	37.95
Tags	71	.19	0.98	13.53	154	.13	0.33	20.40
Total Off-sorts	152	1.03	11.34	156.27	615	.86	8.63	529.75
TOTAL SORTED	152	9.06	100.00	1,377.57	615	9.99	100.01	6,141.35

1950 WOOL SORTING SUMMARY

Targhee Rams

Description	Yearling Rams: No. of fleeces contributing	Yearling Rams: Ave. wt. per fl. contributing	Yearling Rams: % of total weight sorted	Yearling Rams: Total weight sorted	Mature Rams: No. of fleeces contributing	Mature Rams: Ave. Wt. per fl. contributing	Mature Rams: % of total weight sorted	Mature Rams: Total weight sorted
Matchings								
64's and Finer								
Fine Staple	48	6.29	29.32	302.0	7	5.30	4.62	37.1
Fine French	4	1.53	0.59	6.1				
60's and 62's								
1/2 Staple	81	5.61	44.12	454.4	22	6.70	18.34	147.4
1/2 French	3	.87	0.25	2.6	2	3.80	0.95	7.6
56's and 58's								
3/8 Staple	33	3.56	11.41	117.5	39	8.23	39.95	321.1
3/8 French	16	.61	0.95	9.8	6	4.12	3.07	24.7
50's	15	.79	1.16	11.9	37	2.75	12.68	101.9
48's					17	3.45	7.30	58.7
46's					6	1.07	0.80	6.4
44's					1	.60	0.07	.6
Total Matchings	92	9.83	87.80	904.3	53	13.31	87.78	705.5
Off-Sorts								
Seedy	86	1.12	9.38	96.60	52	1.16	7.48	60.15
Stained	70	.36	2.48	25.50	45	.76	4.27	34.30
Tags	24	.15	0.35	3.60	20	.19	0.47	3.80
Total Off-sorts	92	1.37	12.20	125.70	53	1.85	12.22	98.25
TOTAL SORTED	92	11.20	100.00	1,030.00	53	15.17	100.00	803.75

1950 WOOL SORTING SUMMARY

Columbia Ewes

Description	Yearling Ewes: No. of fleeces contributing	Yearling Ewes: Ave. wt. per fl. contributing	Yearling Ewes: % of total weight sorted	Yearling Ewes: Total weight sorted	Mature Ewes: No. of fleeces contributing	Mature Ewes: Ave. wt. per fl. contributing	Mature Ewes: % of total weight sorted	Mature Ewes: Total weight sorted
Matchings								
64's and Finer								
Fine Staple					2	5.90	0.21	11.8
60's and 62's								
1/2 Staple	16	2.89	3.41	46.3	35	5.90	2.82	159.8
1/2 French					4	4.28	0.30	17.1
56's and 58's								
3/8 Staple	114	5.92	49.78	675.3	167	4.45	13.14	743.9
3/8 French	3	5.87	1.30	17.6	20	2.94	1.04	58.7
50's	125	2.32	21.39	290.2	373	4.60	30.31	1716.5
48's	88	1.15	7.46	101.2	463	4.03	32.95	1866.0
46's	11	.57	0.46	6.3	272	1.89	9.07	513.6
44's					59	1.03	1.08	61.0
Total Matchings	145	7.84	83.80	1136.9	554	9.29	90.92	5148.4
Off-Sorts								
Seedy	137	.80	8.06	109.35	514	.85	7.70	436.0
Stained	130	.50	4.79	65.00	272	.21	1.03	58.1
Tags	115	.39	3.35	45.40	150	.13	0.36	20.15
Total Off-sorts	145	1.52	16.20	219.75	554	.93	9.09	514.25
TOTAL SORTED	145	9.37	100.00	1356.65	554	10.22	100.00	5662.65

1950 WOOL SORTING SUMMARY

Columbia Rams

Description	Yearling Rams: No. of fleeces contributing	Yearling Rams: Ave. wt. per fl. contributing	Yearling Rams: % of total weight sorted	Yearling Rams: Total weight sorted	Mature Rams: No. of fleeces contributing	Mature Rams: Ave. Wt. per fl. contributing	Mature Rams: % of total weight sorted	Mature Rams: Total weight sorted
Matchings								
60's and 62's								
1/2 Staple	3	5.10	1.22	15.3				
1/2 French	1	1.50	0.12	1.5				
56's and 58's								
3/8 Staple	88	7.97	55.79	701.0	10	7.32	10.36	73.2
3/8 French	3	3.13	0.75	9.4				
50's	91	2.80	20.28	254.9	22	6.80	21.17	149.6
48's	55	1.51	6.62	83.2	38	7.54	40.53	286.4
46's	6	.70	0.33	4.2	28	3.65	14.48	102.3
44's	1	.50	0.04	0.5	10	1.57	2.22	15.7
Total Matchings	106	10.09	85.15	1070.0	45	13.94	88.76	627.2
Off-Sorts								
Seedy	103	1.31	10.77	135.35	45	1.19	7.55	53.35
Stained	85	.50	3.41	42.90	35	.51	2.52	17.80
Tags	38	.22	0.66	8.35	29	.29	1.18	8.35
Total Off-sorts	106	1.76	14.84	186.60	45	1.77	11.25	79.50
TOTAL SORTED	106	11.85	99.99	1256.60	45	15.70	100.01	706.70

a higher proportion of wool sorted into matchings and less in offsorts than did yearlings. The percentage of wool in offsorts varied from 8.5% for Rambouillet mature ewes to 15.7% for Rambouillet yearling ewes. In general, the largest offsort was "seedy" followed by a smaller amount of "stained" and usually with a very small amount sorted into tags. A large number of fleeces had no tag sort.

The proportions of wool placed in the various matchings was similar to the proportions of fleeces in the various grades at shearing time, particularly for Rambouillets. There was a tendency to place more of the Targhee and Columbia wool in the coarser grades of matchings than would be expected from fleece grades at shearing.

COOPERATIVE STUDIES WITH 1950 CLIP

Processing of 1950 Wool:

Approximately 29,000 pounds of grease wool were used in cooperation with The Wool Division, Livestock Branch, Production and Marketing Administration for studies of the commercial values of sorted wools. These wool sorts were processed into top by a commercial scouring and combing company. The accompanying table is a summary of the processing of each lot into top, noil and waste.

Carding of Individual Targhee Fleeces:

Main sorts of 95 yearling ram and 152 yearling ewe fleeces were scoured and carded individually by the Animal Husbandry Division, Beltsville, Maryland. Preliminary analysis of the data shows the following information:

Age and Sex	Grade					
	Fine Staple		1/2 Blood Staple		3/8 Blood Staple	
	Mean card yield (%)	Standard deviation (%)	Mean card yield (%)	Standard deviation (%)	Mean card yield (%)	Standard deviation (%)
Yearling rams	85.39	2.25	86.99	2.55	87.28	3.40
Yearling ewes	87.65	2.14	89.41	2.36	90.31	0.91

The worsted carding machine used in this work is gauged for 56-58's wool and therefore it will not treat all grades exactly alike. It is relatively impossible to adjust the machinery for every grade. The relative yields are consistent in that Fine Staple yields less than 1/2 Blood Staple and the latter less then 3/8 Blood Staple. It appears that these average card yields are lower than those obtained on comparable lots of

Summary from Processing Each Lot

Description	Grease net weight	Scoured weight 14%*	Percent of yield	Weight of top 14%*	Weight of noil 14%*	Weight of waste 14%*	Percent of top	Percent of noil	Percent noil of top and noil	Sale value per grease pound Dubois	Apparised value per grease pound Dubois [5]
64's, 70's Staple	9,300	4,513	49.0	3,753	635	94	40.4	6.8	14.5	$1.08[1]	$1.03
64's, 70's French	3,556	1,639	46.0	1,346	158	39	37.9	4.5	10.5	.93[1]	.93
60's, 62's Staple	1,675	849	51.7	718	83	43	42.9	5.0	10.4	1.02[1]	.99
60's, 62's French	965	495	51.0	419	34	18	43.5	3.5	7.5	.91[1]	.78
56's, 58's Staple	2,467	1,249	50.8	1,067	121	43	43.3	4.9	10.2	.99[2]	.84
56's, 58's French	711	360	51.9	319	20	21	44.9	2.8	5.9	.92[2]	.69
50's	2,464	1,337	55.3	1,177	92	48	47.8	3.7	7.2	.89[4]	.76
48's	2,062	1,171	55.4	1,028	61	47	49.9	3.0	5.6	.93[4]	.70
46's	743	426	56.7	371	26	24	50.0	3.6	6.7	.95[4]	.64
Seedy-stained											
60's and Finer	2,330	993	43.4	737	136	68	31.7	5.8	15.6	.75[2]	.50
58's & Coarser	1,357	613	45.9	493	48	43	36.4	3.6	9.0	.69[2]	.46
Fine Crutching	656	226	34.5	148	38	30	22.6	5.9	20.6	.48[3]	.36
Cross-bred Crutching	588	270	44.8	197	30	37	33.6	5.2	13.3	.64[3]	.37

* Moisture content
1 Based on selling price of top on November 20, 1950.
2 Based on selling price of top on December 8, 1950.
3 Based on selling price of top but date of sale uncertain.
4 Based on appraisals of selling value of top.
5 Appraisals placed on grease wool (clean basis) just before scouring in October, 1950

of the balance of the 1950 clip (97% for Fine Staple and 96% for 1/2 Blood Staple and 3/8 Blood Staple) by a commercial scouring and combing company.

A preliminary study was made at Beltsville to determine if the average fly waste, which represents the wool and extraneous matter falling beneath the carding machine and that deposited on the shafts of the rolls, could be predicted from the card wastes collected by the 5 card waste conveyers.

The simple correlations of the sum of the 5 card wastes with fly waste were 0.78 and 0.83 for yearling rams and ewes respectively. The multiple correlations of the 5 individual card wastes and the sum with fly waste were 0.79 and 0.91, respectively, for rams and ewes. It was concluded that fly waste could be predicted from the 5 card wastes with reasonable accuracy, thus eliminating the cost of collecting the fly waste after carding each fleece.

Further analysis of carding data will be made to determine relationships to other traits and to obtain estimates of heritability.

Top making Under Contract with Forstmann Woolen Company:

Wool made available for top making through contract with The Forstmann Woolen Company, Passaic, New Jersey, consisted of 1,500 pounds Fine Staple, unscoured matchings from mature Rambouillet ewes; 1,500 pounds 60/62's Staple, unscoured matchings from mature Targhee ewes; and 1,500 pounds 56/58's Staple, unscoured matchings from mature Columbia ewes.

Wool Standardization Studies:

Approximately 75 pounds of grease wool from mature ewe matchings of each of the following grades, 64's, 62's, 60's, 58's, 56's, 50's, 48's and 46's, were transferred to the Livestock Branch, Wool Division, Production and Marketing Administration, for processing research and wool standardization studies.

Properties and Usefulness of Wool in Fabrics:

Two units of mature Columbia ewe matchings were made available to the Textiles and Clothing Division, Bureau of Human Nutrition and Home Economics, for studies of the properties and usefulness of wool in fabrics. These units consisted of 321 pounds of 50's and 328 pounds of 48's.

COOPERATIVE WORK WITH FOREST SERVICE

SPRING-FALL RANGE

Rotation and rotation-deferred grazing by sheep:

Continuous grazing during the spring growing season has long been recognized as one of the major causes of range deterioration. In order to prevent deterioration various methods of rotation and deferred grazing have been both proposed and followed. A simple rotation plan permits an area to be grazed fairly intensively for a short period at a different part of the grazing season each successive year. Thus, with four pastures on a 4-year rotation, each pasture would be grazed for only one-fourth of the season and at a different part of the season each year. A rotation-deferred plan also shifts the seasonal use of pastures, and in addition requires complete deferment of each pasture during one year of rotation.

A study of rotation and rotation-deferred grazing by sheep on spring-fall range was started at the Upper Snake River Research Center in 1941. This study consisted of three intensities of use under a simple rotation plan, and a single intensity under a rotation-deferred plan. Since fall use has comparatively little effect upon herbaceous species, the rotation systems were only in force during the spring. The pastures were all grazed at the same time in the fall, at spring intensities. The spring stocking rate for each of the four systems was as follows:

Light rotation-------14 sheep-days per acre
Moderate rotation----18 sheep-days per acre
Heavy rotation-------22 sheep-days per acre
Rotation-deferred----18 sheep-days per acre

Each system consisted of four pastures, and a complete rotation was accomplished in 4 years. The sheep were only in each pasture for a period of 10 to 18 days during the 40- to 45-day spring grazing season.

This study has now been through two complete rotations and is well into the third. The effects of the treatments on the vegetation have not yet been evaluated. However, weights of ewes and lambs grazed under these four systems demonstrate the effect of the three stocking intensities as well as differences between a simple rotation and a rotation-deferred plan. Although actual weight variations are not great, the trends (table 1) are important.

Pastures in the lightly stocked rotation consistently produced heavier ewes and lambs than in either the moderate, heavy, or rotation-deferred systems. Similarly, moderate stocking generally resulted in heavier sheep weights than heavy stocking.

Table 1. Effect of four systems of grazing on sheep weights[1]

Treatment	Sheep-days per acre	Average body weights[2]					
		1947		1948		1950	
		Ewes	Lambs	Ewes	Lambs	Ewes	Lambs
		Pounds					
Light rotation	14	131.12	51.03	133.95	43.89	134.55	44.58
Moderate rotation	18	128.60	47.67	129.45	43.46	133.27	43.40
Heavy rotation	22	120.94	46.68	129.52	42.70	130.85	40.66
Rotation-deferred	18	129.67	46.67	128.54	41.81	132.18	41.89

1 Adjusted to original weights by covariance analyses.
2 Pastures were not grazed in 1949.

Sheep weights indicate, however, that a rotation-deferred plan is inferior to a simple rotation. although the moderately stocked rotation and the rotation-deferred system both received a 4-year average spring use of 18 sheep-days per acre, actual use of the rotation-deferred system for 3 of the 4 years amounted to 24 sheep-days per acre . (Each year the three grazed pastures absorbed the sheep-days use from the one deferred pasture.) Consequently, the actual stocking rate, with respect to competition for forage between sheep, was even a little greater than that of the heavily stocked rotation. This was reflected by similarity of sheep weights between the rotation-deferred and heavy systems. Possibly the study has not been active long enough to cause sufficient vegetal changes to be reflected in the sheep weights.

Although one might expect, superficially, that light stocking would produce greater gains than heavy stocking, this is not easy to explain, since both the light and moderate rotations were in fairly good condition. In fact, pastures in all the systems produced ample forage (table 2), and were at no time completely utilized. This suggests that both ewe and lamb weights are fairly sensitive to the abundance of especially desirable feed, and that competition between sheep for the more desirable species, despite availability of other forage, may be more of a factor in governing sheep weights than is ordinarily recognized. The similarity in weight of sheep in the rotation-deferred and heavy rotation systems adds support to this suggestion. Probably this possibility should be taken into consideration when any grazing plan involves a high intensity of stocking for a short period of time.

Table 2. Herbage production in 1949 in pastures subjected to four systems of grazing.

Treatment	Sheep-days per acre	Dry weight of herbage		
		Grass	Forbs	Shrubs
		Pounds per acre		
Light rotation	14	141	89	349
Moderate rotation	18	120	115	466
Heavy rotation	22	114	73	482
Rotation-deferred	18	151	73	449